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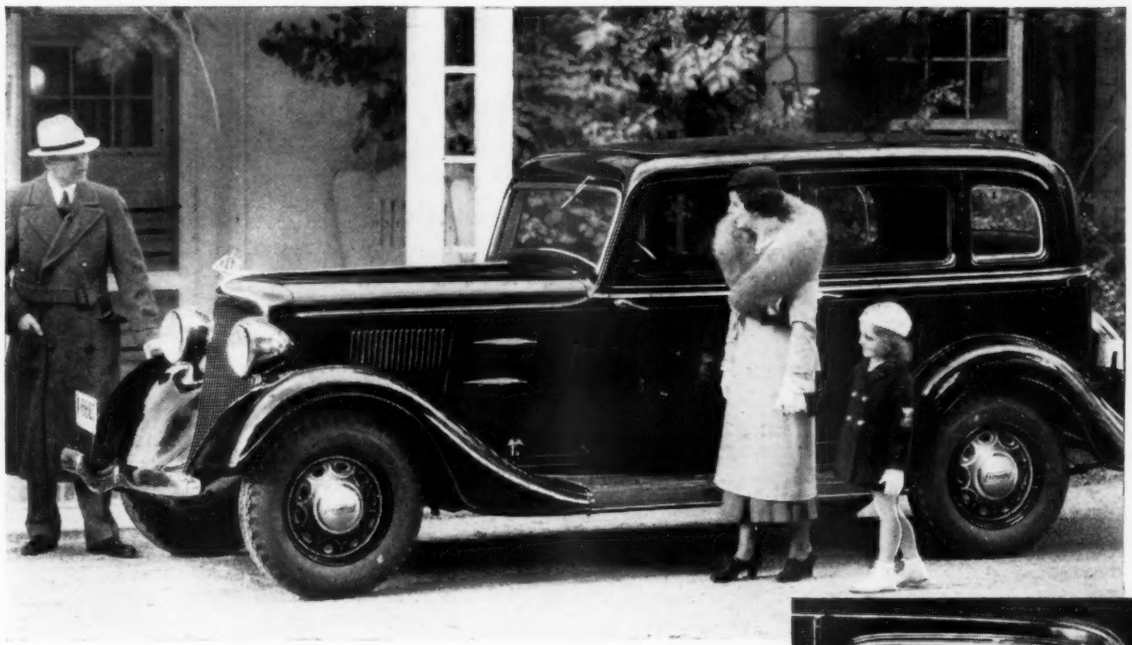
FULL MECHANICAL STORY OF 1934 PLYMOUTH SIX



Read this Amazing Story... *and you'll agree Plymouth is the best engineered car in the Low-price field*

WHAT'S the big news about the 1934 Plymouth? In a nutshell, simply this: Plymouth is not only a car with new features—it's a *whole new car built for better riding!*

Plymouth engineers laid the foundation of truly comfortable riding years ago when they perfected Floating Power engine mountings and eliminated engine vibration.

This year they add a "levelized" ride by replacing the usual front axle with individual wheel springing in even the lowest priced models!

Reserve power has much to do with driving pleasure. So this year's engine is a 77-horsepower six.

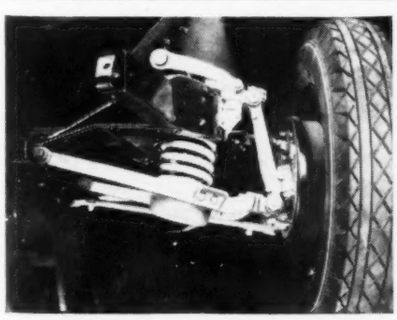
The braking system is, of course, hydraulic. But to the smooth, self-equalizing action of this system, Plymouth has added in the De Luxe models . . . still greater efficiency by increasing braking surface one-third.

Bodies on all Plymouth models are of modern safety-steel construction. Steel is reinforced with steel for safety — then welded permanently together for long car life with quiet and perfect safety.

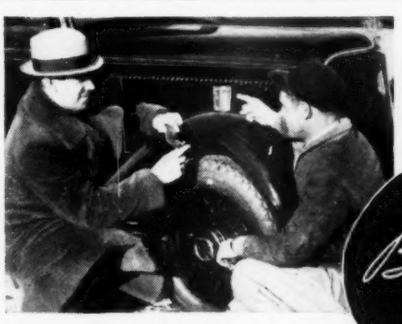
All-Weather Ventilation in De Luxe models.

Plymouth is the only low-priced car with Floating Power, hydraulic brakes and safety-steel body as well as individual front wheel springing.

See Plymouth at the nearest Dodge, De Soto or Chrysler showroom and you will see the best engineered car of the low-price field.



INDIVIDUAL SPRINGING on the Plymouth is simple, easily accessible, dependable. There is no longer any front axle.



A PRACTICAL TEST of Floating Power. The engine is racing, the glass of water on the fender does not tremble.

IT'S THE *Best Engineered* CAR IN THE LOW-PRICE FIELD

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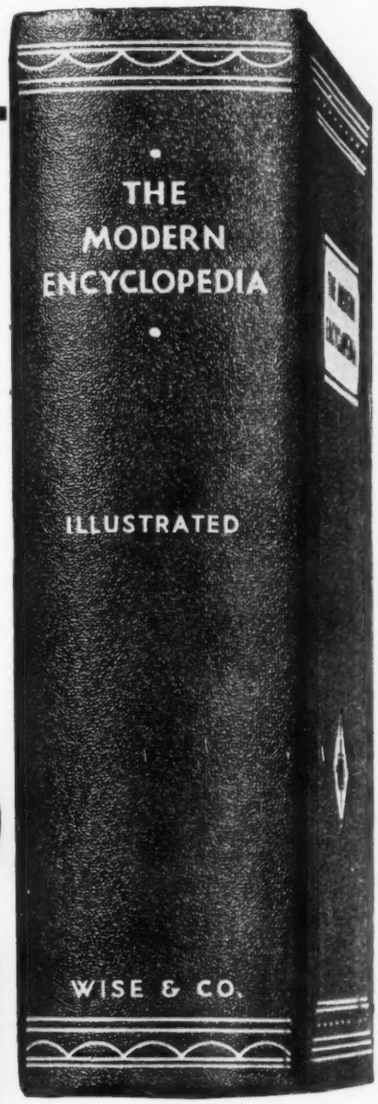

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In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

BUT IT'S FAIR AND WARM BY TELEPHONE!

Outside, hurrying feet plod on against the winds and swirling snow of winter. On such a day, it is good to be indoors where all is snug and warm.

• • •

ALL outdoors may be frowning, the thermometer close to zero, street travel an exhausting task. Yet to your telephone it is as clear and fair as a day in June.

Without moving from your chair at home or in your office, you can send your voice across the snow-swept miles. Wind and weather need not delay the necessary tasks of business or break the ties between friends and relatives. Through all the days of the year, the telephone is your contact with the world beyond your door. It knows no season—no letting up when the going gets hard. Through storm and flood, an army of trained employees works ceaselessly along the highways of speech.

This very day, as you talk so easily from the warmth and comfort of your home, a lineman may be scaling a pole far out on a frozen mountainside—so that the service may go on. So that you may talk to almost anyone, anywhere, at any time.

Make someone happy these winter days through a voice visit by telephone. A boy or girl at school, a mother or father in another city, or a good friend away on a visit. To most places 175 miles away, for example, the rate for a station-to-station call is 95c in the daytime, 85c after 7 P. M., and 55c after 8:30 P. M.

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Motorists Wise

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KEEPS CARS BEAUTIFUL

Better *than* Money *in the* Bank

By Thomas J. V. Cullen

Note: Mr. Cullen is Editor of THE SPECTATOR, one of the country's leading insurance papers. This article was written by him at our special request, for we felt that the interest of Popular Science Readers in the subject of life insurance, and the importance of it in today's financial conditions deserved the attention of a specialist and recognized authority, such as Mr. Cullen is.—The Editor.

THERE is an army in this country so large that it exceeds the total of all mobilized troops engaged in the World War by 20,000,000 in numbers! It is the army of people directly concerned with and affected by life insurance.

Policyholders alone number 65,000,000 —and a conservative estimate of named beneficiaries, exclusive of these policyholders, raises the total to 85,000,000. If this figure is too large to comprehend and digest by itself, a comparison may make its importance clearer. Savings banks have 40,000,000 depositors; stock and bondholders total 20,000,000.

When any one financial structure can embrace so huge a number of people, when any single investment channel can affect in some way or another seven out of every ten people in this country, its soundness certainly becomes the concern of everyone.

As this article goes to press, the President of the United States is asking his Congress to approve a budget of ten billion dollars. To conceive of this amount as one lump sum of money is practically beyond human imagination or capability. Put in another way, a man would have to live 19,049 years and 32 days and spend a dollar every minute of his superlife to use up ten billion dollars!

Yet, 65,000,000 policyholders have contributed toward building twice that amount—twenty billion dollars—in assets for the combined life insurance companies in this country! Naturally this money in turn has been re-invested by these companies. Today these policyholders have a tremendous stake in every important American industry. Where, specifically, has this money gone?

It has supplied the railroads with 29% of all the capital which supports this industry—and the two million people working in it. Policyholders have supplied 14% of all the money behind the bonded indebtedness of our public utility companies. In addition, they hold 4% of all the outstanding Government bonds and 7% of the outstanding obligations of all states, counties and municipalities in the country. They have advanced something like 20% of the farm mortgage loans and 16% of the total mortgage loans on all types of real estate, as well.

That's a great deal of money to hand out. Has it been invested wisely or has it gone up in smoke, like so many other investments made in the last five years? Look at the record. For every day of the three hundred working days in every year since 1929 life insurance companies have paid between seven and ten million dollars to people who benefited by maturity of policies or who were in need of cash on those particular days. One can't begin to visualize how much worse the country's condition might have been during the last four years of depression had it not been for the integrity and assistance of life insurance companies.

IT WILL be seen then that no financial institution has come through the depression with a performance to equal the record of life insurance companies in respect to stability and management. For, as a result of sound management life insurance not only met its every obligation and performed its every function during these last four years, but also it closed its books in December, 1933, with almost four billion dollars more assets and almost two hundred million dollars more surplus funds than were on hand at the end of 1929.

That growth is the result of the consistent confidence which the American people have placed in the financial soundness and good management of life insurance. It has contributed to the ability of life insurance companies to meet their obligations dollar for dollar during the depression without undue stress or impairment of reserves. *(Continued on page 8)*

A HEART-TO-HEART TALK ABOUT YOUR FINANCIAL PROBLEMS

Your LIFE INSURANCE is your Best Investment

Hold on to what you have . . . add to it when you can

Take a few minutes today and look back over the record of your investments during the last four years. Which has given you the least worry? Which has been affected least by the storms of panic and depression? The chances are that your life insurance policy has had the best record of any investment that you own.

There are good reasons why the record of life insurance has been so outstanding during the four black years of depression.

Conservatism

The money you invested in your life insurance policy has been reinvested in carefully selected bonds, mortgages and other securities. Although life insurance investment men are not magicians, they are trained specialists in their respective fields. Their investments are conservative, based on safety, soundness and security rather than possible profits or highly speculative yield.

Steady Income

Then, too, life insurance has the advantage of a steady flow of premium and interest income from all over the country, both in good times and bad. This income makes it unnecessary to sacrifice choice investments for cash.

Diversification

Furthermore your life insurance policy represents not one investment but *thousands* of investments, backed by ample reserves and supervised by insurance commissioners of the various states. From this spread of sound investments your individual policy gains security and strength.

• • •

Speculation Versus Certainty

Should there be a repetition of the speculative fever of the boom era, there will be a temptation to overlook the steady, consistent safety of life insurance as an investment and to turn toward speculative investments which promise huge profits, quickly made. You will be asked to take a gambler's chance, but do not be misled. Hold fast to that which is good! In good times and bad, your life insurance policy will prove to be the backlog of your financial investments, if past experience means anything.

Substitution

You may also be advised to switch your life insurance from one company or plan to another on the plea that you can save money. On the contrary, you probably stand to lose money. No matter how attractive the new proposition seems on the surface, investigation usually shows that, dollar for dollar, the life insurance policy you already own is better than the new one because of the fact that the older a policy is, the more valuable it tends to become. Before you authorize *anyone* to change your life insurance from one permanent form to another, write to the company which issued your policy, or to the insurance commissioner of the state in which you live.

Your Best Investment

Your life insurance is your best investment. Hold on to what you have and add to it when you can. Naturally, we hope that you will add your next policy in the Provident Mutual, whose record of service and safety has been unsurpassed since its founding in 1865. But whether through Provident Mutual or some other well-established, conservatively managed company, invest in life insurance. It will pay!

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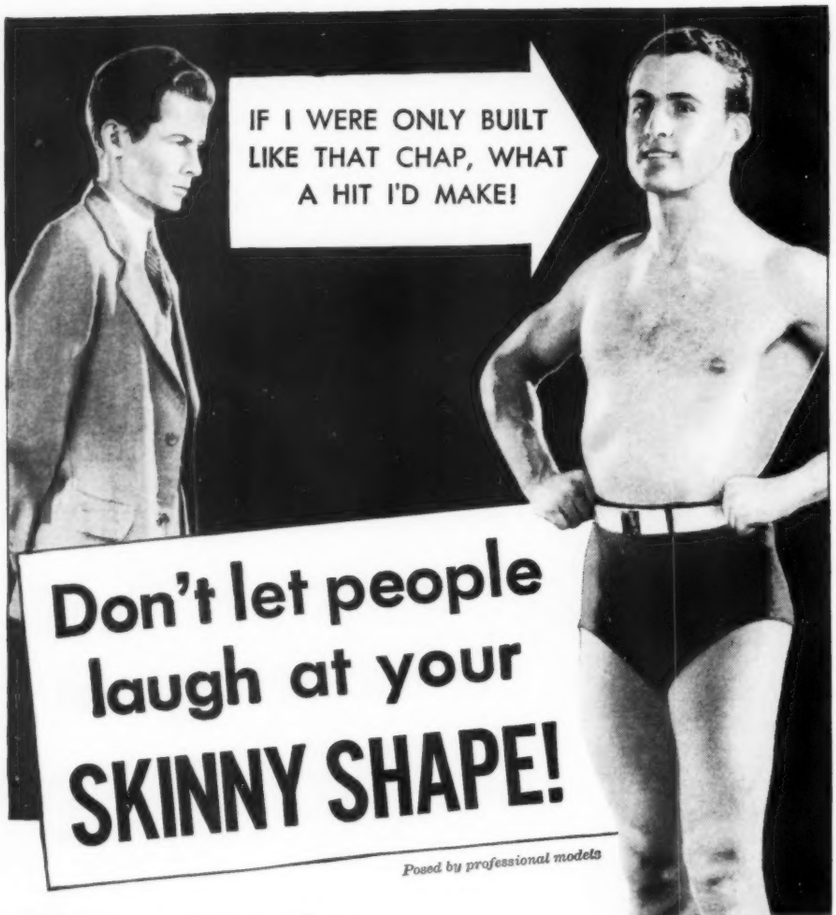

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Not only are thousands quickly gaining solid, good-looking pounds, but also clear, healthy skin, freedom from indigestion and constipation, new pep.

Concentrated 7 times

This amazing new product, Ironized Yeast, is made from specially cultured *brewers' ale yeast* imported from Europe —the richest yeast known—which by a new process is concentrated 7 times—*made 7 times more powerful.*

But that is not all! This marvelous, health-building yeast is then *ironized* with 3 special kinds of iron which strengthen the blood, add abounding pep.

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Results guaranteed

No matter how skinny and weak you may be, this marvelous new Ironized Yeast should build you up in a few short weeks as it has thousands. If you are not delighted with the results of the very first package, your money will be instantly refunded.

Only be sure you get *genuine* Ironized Yeast, not some imitation that cannot give the same results. Insist on the *genuine* with "IY" stamped on each tablet.

Special FREE offer!

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BETTER THAN MONEY IN THE BANK

(Continued from page 6)

"That's all very well," a person may say, "but some life insurance companies failed, didn't they?" Yes, they did—and since the question is brought up, let's answer it now.

Ninety-five per cent of the life insurance companies which were actively functioning at the close of 1929 are in operation today, paying all claims in full as they occur. The companies which did fail represent something less than 3% of the total assets and about 1½% of the total life insurance in force. Certainly that's a splendid record. Certainly no other branch of our financial structure can stand up to it in a figure-to-figure comparison. If only that small percentage of the banks in this country had gone under in the last four years, there would never have been a bank holiday back in March, 1933. It wouldn't have been necessary.

But remarkable as this record is, even so small a fraction of insolvency should not be allowed to cast any reflection on the entire system of legal reserve life insurance. For the ones that did fail can blame their failure on poor management. It can be truthfully said that no soundly managed life insurance company even approached insolvency during the depression. The failures can be traced without exception to men and methods which were foreign to the accepted high standards of life insurance.

In some cases ownership fell to men who were more interested in the business of stock manipulation than they were in the business of insuring lives. The investments of these companies were deflected into speculative undertakings which yielded to the weight of the depression. However—and this is important—even in these cases re-insurance was effected, death claims guaranteed and protection—the primary purpose of life insurance—fully maintained.

FROM the preceding facts and figures it becomes apparent that there is hardly a reader of this magazine whose welfare and security are not, to some direct or indirect degree, dependent upon the continued success of the life insurance companies of this country.

Life insurance is an institution which has been built on a scientific and sound foundation. It has come through three major wars, five serious depressions and innumerable epidemics. Today it is larger in size and transacts a greater volume of business than any other industry in the United States.

We hope it has been shown that life insurance has done its job, and done it well, and that by doing it life insurance has earned the continued faith of you and the 85,000,000 other people who are concerned with it. In conclusion it may be said that no one investment offers the rich, poor or average man the same, equal opportunity for entrusting large or small funds with utmost security and dependable returns that legal reserve life insurance does.

Complete Construction Kit FOR A *Clipper Ship* Model

EVERYTHING you need to make a beautiful little miniature model of the famous American clipper *Sea Witch* is contained in a construction kit offered by the Popular Science Homecraft Guild. Unlike all previous clipper ship models, this one has been so greatly simplified that anyone can build it. Indeed, it is what is called a "pocketknife" model because so much of the work can be done with a penknife and a few single-edged razor blades.

The hull of the model is 9½ in. long, but the over-all length is 13 in., and it stands 8 in. high. The kit contains the hull carefully sawed to shape by hand from accurate master templates; half a dozen pieces of pine cut to approximate sizes for the deck fittings and boats; hardwood for the keel, stem, sternpost, rudder, and other parts; three sizes of round stock for the masts and spars; fiber for crosstrees and caps; thin hand-dyed linen rigging cord of the finest quality; thread, small chain, beads, fine wire, casein glue—in fact everything but the paint.

Postpaid Complete $1.50

Popular Science Homecraft Guild,
381 Fourth Ave., New York, N. Y.

Please send me a complete construction kit (except paints) and a blueprint for building a miniature model of the clipper ship *Sea Witch*. I inclose $1.50.

Name .....

Address .....

City..... State.....

(Print very clearly)

NOTE: This kit is not sent C. O. D.

A Sensational New Business

That—Almost Overnight—Can

Sweep You to Riches

This is among the first public announcements of what is undoubtedly the most amazing money-making opportunity ever offered to the readers of this—or any other—magazine. It tells how any ambitious, level-headed man can establish—practically overnight—a remarkable new kind of business that can pay a steady net cash profit of $40.00 a day—a business that offers unlimited opportunity—a business that is destined to make many men independently wealthy.

HERE, briefly, are the "high-spots" of this thrilling new business that will create "fortunes" for those with the vision and foresight to get in on the ground floor now:

1 **An utterly new product with a natural, staple demand and big repeat business, yet one that has all of the appeal of a novelty.**

2 **Requires no house-to-house canvassing or selling. You simply manufacture. Stores will sell your entire output.**

3 **Produces $40.00 a day net profit, selling your entire output at wholesale.**

4 **Pays steadily; no lean seasons.**

5 **Big profits to be made in smallest town or largest city.**

6 **Absolutely no experience needed to be successful.**

7 **No expensive equipment needed. Your whole investment will be less than your first week's potential income.**

This is truth; not fiction—fact; not theory. To the best of our knowledge, no other business in America offers one-tenth the opportunity for profit and independence.

Vision Turned to Reality

A few months ago, this amazing money-making product was nothing more than a dream—the vision of its inventor. Today, the process is a reality with every detail perfected—complete with tested plans of operation worked out—all necessary equipment ready to turn over to those who are prepared to develop this new "gold mine."

No Selling—No Canvassing

Do not confuse this new product with anything you have ever heard of before. It is not a potato chip, not candy, not a cheese chip, not a paste preparation, not a popcorn—but a natural product that comes from the sky, from the ground, and from the air. It is not like anything you ever saw or heard of, or imagined. The simple truth about it is stranger than your wildest dream. And you can be the first to supply this great demand, selling your entire output at wholesale to stores.

$100.00 a Week, Net, to Start

According to accurate figures, the very minimum of the first operation should produce a net cash profit of at least $100.00 a week. Since it is possible to make $40.00 a day, you can see that it would take only two and a half days of full operation to make a profit of $100.00. This, we figure to be a minimum. We would not be interested in licensing men who could not make at least that much every week. Then, as demand increases, additional men can be put to work for you and you can double your weekly profit as steady repeat business develops.

No Expensive Equipment

Ordinarily a proposition as big as this would require the purchase of expensive equipment. But our manufacturing process has been so simplified that we can furnish you with everything you need, start off making a profit the very first day—all for an investment of less than $150.

No Experience Needed

Absolutely no experience is required to quickly become successful in this thrilling and fascinating new business. We tell you how to start—how to establish yourself quickly—how to operate the business the very day you are ready to go. We furnish all necessary plans, systems and equipment. Any man with ordinary intelligence and a real desire to succeed is bound to make money.

Small Town or Big City

Another feature that makes this business unlike any other is that it can be operated anywhere. No matter where you live—in the smallest town or the largest city—you can establish yourself practically overnight and start enjoying an independent income at once. From the foregoing facts, you can readily see that this is not a business for the timid operator who is satisfied to make a bare living, but for the wide-awake, aggressive go-getter who wants to see his energy and enthusiasm produce the greatest possible results in the shortest time.

Facts Sent Free

To all such men, we request permission to mail an unusual and complete presentation. After you have read the amazing facts and figures in this presentation, then you can decide whether or not an initial investment of less than $150.00 is too much to ask for a complete business that can pay back that investment in the first week of operation, and then continue to pay as much as $252.00 a week net profit to those men who have the ability to organize and direct other men.

Act Quickly

There is no time to lose. Today this proposition is new. Tomorrow it will be a little older—next week a little older still. So get the facts without a moment's delay. It's the newcomers in any enterprise of this sort—the "ground floor operators"—who always reap the richest rewards.

There is no coupon on this page. We do not want to hear from coupon clippers. If you don't agree that this is worth a letter—or a telegram—you are not the man for the business.

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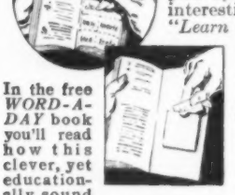

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Radio *at* New Peak

with many

NOVEL FEATURES

By
R. M. BOLEN
Secretary,
Popular Science Institute

One of the larger units now available. It is an all-wave set, covering all the bands

A super-midget that is small enough to fit in an overcoat pocket. It uses two tubes

NEVER before in the history of broadcasting have radio manufacturers offered the public so much in the way of novel receiver features.

Glancing over descriptions of the latest models one finds such conveniences as automatic-volume control, visual tuning, universal A.C.-D.C. circuits, all-wave dialing, compact cabinets, automatic-tone control, and silent tuning. Each one a step toward the goal of perfect radio reception.

In terms of convenience, quality, selectiveness, and sensitivity, the radio fan's dollar was never worth more. To make up for the deficiencies of the human ear, radio engineers devised an automatic tone control. Operating in conjunction with the volume control, it serves automatically to adjust the high and low frequencies, increasing them with respect to the middle register when the receiver is set for low volume. Coupled with improved speakers, used singly and in pairs, automatic tone control makes improved fidelity possible.

Although automatic volume control is not entirely a new feature, it has come into more general use in the newer sets. With it, signals can be received at a constant volume without the annoyance of blasting or fading. For any one setting of the volume knob, the amplification is varied automatically and accurately to bring in all stations with equal strength.

Silent tuning is just what the name implies. It is tuning minus the ear-splitting snarls and sputters. An ingenious automatic-noise eliminator, acting like a gate, cuts out all the unwanted noises. Between stations, you hear nothing.

Besides tending toward automatic features, however, the present day radio shows another definite trend—compactness and fewer tubes.

A year ago, pigmy receivers having four or five tubes housed in tiny cabinets took the country by storm. Operating on direct as well as alternating current, these jewel-box midgets were found to give surprising performance for a minimum of space.

Today further developments are being made along this same line. Only recently a large manufacturer of compact receivers announced a new super-midget. A tiny two-tube loudspeaker set that can be tucked easily into your overcoat pocket. Complete, the entire receiver, which operates on direct as well as alternating current, measures *(Continued on page 11)*

RADIO AT NEW PEAK WITH NOVEL FEATURES

(Continued from page 10)

only three by four by five inches.

In viewing the 1934 radios in general, one finds that this germ of compactness has spread. Even many of the larger circuits are being housed in smaller cabinets. Almost every manufacturer now features semi-compact six-tube superheterodynes that are the equivalents of earlier eight-tube sets. Multi-purpose tubes have made space saving in larger circuits possible.

In his search for a suitable receiver, the enthusiast has three general classes to choose from—midgets, semi-midgets, and regular full-size outfits. Each group has its advantages and each fills a need.

During the past year, the shorter waves have gained in popularity. What was once the domain of the amateur experimenter is now a field of exciting exploration and fun for the regular radio fan.

This short-wave hobby has fostered the growth of a new group of sets—all-wave receivers. Many of the larger circuits are now equipped to bring in European, amateur, and police stations as well as the regular broadcast band. Even the smaller compact and semi-compact models show the short-wave trend by making it possible, by the flick of a switch, to bring the adventurers of the police band into your living room.

New and improved battery-operated receivers also are available. Homes not wired for electricity now can enjoy all the comforts of a modern radio. Such features as automatic volume control, full tone dynamic speakers, automatic noise reduction, tone control, and up-to-date cabinets have been incorporated in the modern battery set.

In most cases, a relatively new and revolutionary air-cell battery forms the filament supply. This improved battery requires practically no attention other than a little water once a month. Yet, its life, without recharging, is about 1,000 hours or almost a year of radio use.

No matter what your 1934 radio desire may be, you can fulfill it. Never before has so wide a choice been available and never before has convenience, tone, and quality been at so high a peak.

In order to make these articles valuable and interesting, Popular Science Institute would like to know more about your particular radio needs. Will you help by answering the following questions:

How many radio sets do you own?

.....

Are they battery or all-electric?.....

.....

What type are they? Broadcast. Short-Wave. All-Wave. Where are they located? Living Room. Bedroom. Camp. Automobile. Kitchen. Game Room. .....

What short-wave programs do you like best? Amateur. Foreign Stations. Ship. Police Calls.....

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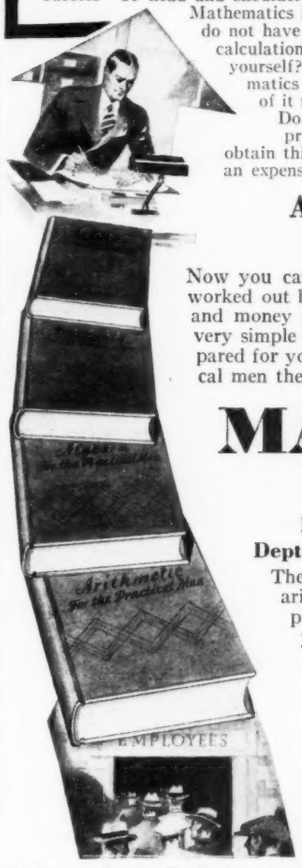

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Our Readers Say

That Round-the-World Idea Surely Sounds Good to the Artist

I SUGGEST that a certain member of the POPULAR SCIENCE MONTHLY staff be sent on a trip around the world to study the subject of national dress. I refer to your cartoonist. His effort, which accompanied my last letter, horrified me in its resemblance to a famous Scotch comedian who is responsible for the impression in America that *all* Scotsmen are garbed as indicated in Our Readers Say. But that is a mere trifle. I read in a recent issue of POPULAR SCIENCE MONTHLY of Miss L. B.'s amusing urge to become a Detective. Obviously she is the victim of movie hallucination. Doubtless she has been inspired by the ingenious unravelling and solving of crime mysteries, by one of Hollywood's glamorous blondes (alleged) who has come into prominence of late through her appearance as the lady sleuth. Or perhaps it is just further proof of woman coming into her own, the spirit of the times, emancipation and sex equality. She wants articles on the work of women in the field of crime. Doesn't she think there is already enough woman interest in the precious pages of this magazine in the household section? I suggest she stick to her numerous movie weeklies.—I. McD., Glasgow, Scotland.

Here's a Heat Problem That May Stir Up Your Wits

WILL some reader please tell me why it is that one can put hot coffee in a vacuum bottle and it will stay hot for ten or more hours and the only thing that keeps it hot is the vacuum between the two bottles? Yet the theory is that the heat the earth receives from the sun during the day is radiated out into space at night and yet the space outside our earth's atmosphere is as good a vacuum as the one in the vacuum bottle. This doesn't seem reasonable to me. —H. N., Benton Harbor, Mich.

Just Buzzing Around Landed This Automobile in the Ditch

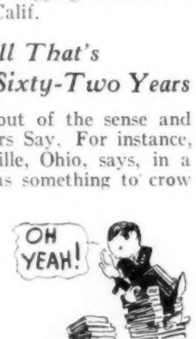
HERE'S one to add to your list of queer things that happen to people in automobiles: A friend of mine was driving along a country road when a mosquito flew in his ear. Its buzzing near the eardrum drove him frantic. In trying to get it out, he ran into a ditch. Finally he had to go to a doctor who poured something in his ear and drowned the insect!"—E. R., New York.

Embarrassing Facts Submitted Regarding Man's Evolution

I COME to defend J. H. P., and to rebut W. H. R. and C. A. S. W. H. R. alleges that, "there is no similarity between a human embryo and the (embryonic) fish" They are, in fact, almost identical up to the last few stages of development. Nor are the gill-clefts to which he refers, "nothing more or less than pharyngial arches." There are six of these gill-clefts, all richly supplied with blood; four of them, with most of the blood vessels, later degenerate. The remaining two are salvaged for use as eustachian tubes. Upon what basis does W. H. R. state that, "the argument for evolution from similarity has been exploded"? If so, how can we explain the identical basic structure of the higher vertebrates; and more fundamentally, of all animals? How is it, then, that the flipper of the whale, the hand wing of a bat, the fore limb of the elephant, and the hand of man all are homologous? Their functions are certainly dissimilar. Is W. H. R. unaware that he has, rabbitlike, an appendix; a remnant of a third eyelid (which the lower primates find very useful); unused nose, ear, and scalp-twitching muscles; and a complete set of tail-wagging muscles?—S. G. F., Los Angeles, Calif.

Good Enough; Still That's Not Much Out of Sixty-Two Years

I GET quite a kick out of the sense and nonsense of Our Readers Say. For instance, M. H. B., of Portersville, Ohio, says, in a recent issue, that he has something to crow about because he has "the issues almost complete back to and including 1925." Now what will he think of this: I have all copies, including covers, back to and including 1921 . . . Here is a question for your readers to figure out: Take two cups of coffee, one sizzling hot and the other luke-warm. From a height of four or five inches, allow a spoonful of sugar to flow slowly into first one cup and then the other. As the sugar enters the luke-warm coffee no appreciable sound will be heard, but as it enters the hot coffee a sort of hissing noise will be heard. How come? Try it out and give me your answers.—J. C. B., Phœnix, Ariz.



Now the Gyroscope Is Asked To Give Perpetual Motion

ON YOUR Our Readers Say page in a recent issue, is a letter concerning a gyroscope, by W. W. A. of New York. I wish to add the following thought on the subject of a gyroscope as an independent body. Gyroscopes, when subject to a torque and moved in one direction, resolve this torque into a turning on an axis at right angles to the applied torque. If then a gyroscope is placed with its axis kept at forty-five degrees to the earth's axis, the turning earth will cause the gyroscope to revolve about an axis perpendicular to that of the earth. All that remains, then, is to secure a gyroscope of small enough friction to turn it, and apply the turning torque as a result of the earth's revolution to the spinning of the gyroscope and the creation of free energy as perpetual motion; the energy being obtained from the earth's rotation.—J. F. D., Norwood, Ohio.

Sunlight's Moving Shadow Confuses This Reader

WILL some of the readers of this good magazine, or the publishers, please explain the cause of the following effect: I have observed for some time that sunlight, shining through a window that is directly over a hot radiator, casts wavy, moving shadows on the wall at the other side of the room in the place where the sunlight strikes the smooth surface of the wall. This effect seems to be caused by the heat from the radiator ascending through the beam of sunlight. A gust of cold air causes the shadows to stop moving for a short time.—E. W. J., Van Buren, Mo.

One Reader, at Least, Wants Plans for a Seismograph

IN SOME of the recent issues of POPULAR SCIENCE MONTHLY, I have read of amateur astronomers building their own seismographs and if they can build them why not print an article on the construction of a simple one such as the one they built? Also why not print a series of articles on the construction of high-frequency phenomena apparatus—induction, Telsa and Oudin coils? Keep up the good work on microscopy and chemistry.—J. F. W., Pittsfield, Mass.

This Cynical Reader Tends To View With Alarm

WHAT a contrast in two inventions that you describe on a single page of your February issue—by some irony, in adjoining articles! One is a device for saving human lives: a lifeboat so skilfully contrived that it may safely be gotten away from the side of a sinking vessel, with its precious cargo, even if undermanned. The other is a device for destroying human lives: a mile-a-minute war tank, ready to spout death from a gun bristling in its

turret. I wonder which inventor is prouder of his accomplishment! And I also wonder if either one has any real significance in our glorious march toward civilization which, as far as I can see, persistently hangs around some remote and obscure corner.—P. B. Y., Scranton, Pa.

Mysterious Knock in Auto Leads to Strange Discovery

I WISH to thank you for the many things of interest I find in every issue of POPULAR SCIENCE MONTHLY, and especially for your articles about automobiles. The many defects that turn up every day in autos, many of which are mentioned in your magazine, make one think an auto is still a mystery. Here is one that I found and it may be a good thing to pass it on to others: I had changed the oil filter and it had been in use for 20,000 miles at least. Afterward I heard a bad knock and went looking for it. While testing every thing, I took off the filter pump and to my surprise I found the opening in the tee on top of the pump leading to the filter was entirely closed. I am sure it has always been closed. The port is naturally small anyway and what would prevent it from becoming clogged any time? Don't you think it would be a good idea to look this over when checking up on the oil system? The filter certainly is no good if it is not getting circulation. By the way, I have not found the knock yet.—M. F. A., Conneaut, Ohio.

Bicycle Rider Challenges the Long-Distance Record

I HAVE just come across an issue of POPULAR SCIENCE MONTHLY in which I find the statement that Charles A. Stoops, in twenty years has ridden 175,000 miles on a bicycle and has worn out three machines. I think I can beat this record as I have ridden 100,000 miles in fifteen years and all on the same machine. I got my first bicycle on the 20th of May, 1918, and finished my 100,000 miles on the thirtieth of last June. Since then I have added 3,500 miles to my total. In July I rode 1,040 miles. In making this mileage I have made no long trips with the exception of several excursions to Seattle, a distance of 114 miles. Otherwise all of my riding has been to and from my home to the city and to other local points. I am now sixty-two years old.—T. S., New Westminster, B. C.

Tear Gas Replaces Lasso in Wilds of Pennsylvania

IN WILD and woolly Pennsylvania, science has done away with the lasso and the cowboy's art of hog-tying. When it came time recently to inoculate a dozen or so tame buffalo that roam the county parks, the attendants used tear-gas bombs to subdue the animals. Just another step forward, I suppose. But somehow, I can't picture a rangy cowboy singing "The Last Roundup," and reaching for a can of tear gas instead of his lasso. And besides, what will become of our wild west shows and rodeos if science modernizes the western ranch?—L. D. V., Pittsburgh, Pa.

Boom in House Trailers Is Confidently Predicted

I AM very much interested in house trailers. Lately, however, I have seen very little in your magazine about these useful conveyances. They are being homemade by the thousands and as conditions become more nearly normal they will be built in ever increasing numbers. I am sure of this because three years ago, when I first started out in mine, it was a novelty. But during the last summer there was a marked increase over the number seen in 1932. I know of eight trailers that have been built from mine and it is hard to say how many were built from those eight. I now have under construction a coach-type trailer with a top and rounded corners. Now I would like to ask why you do not run a series of articles telling, from the ground up, exactly how to design and build trailers? Also there should be a set of blueprints for each unit and chassis so the uninitiated would have no trouble with the work.—W. P. M., Mansfield, Ohio.

Lost in His Attic, He Finds a Forty-Year Old Treasure

IMAGINE my pleasure and surprise when during a search through the attic I discovered three issues of POPULAR SCIENCE MONTHLY of the years 1891 and 1892. The issues, which are well preserved, are for February and June, 1891, and September, 1892, and carry articles that stand up well after more than forty years of scientific progress. The magazine, as published at that time, sold for fifty cents. While the magazine was not as profusely illustrated as is the modern version, it was gotten up more like a permanent book. Each issue featured "New Chapters in the Warfare of Science," by Andrew D. White, LL.D., L.H.D., and the supporting articles cover a wide range of interest, all the way from tobacco and the tobacco habit, to the decline of bibliolatry and the Delaware Indian as an artist. There is a section devoted to reader correspondence in some of them, and a department entitled The Editor's Table. The ads are an education in themselves, showing as they do the trend of style and thought. An especial feature is the modern, up-to-the-minute typewriters, and the latest model bicycles afford much interest, being mentioned in one place as selling for $165. In the Popular Miscellany section I find the following: From the opening of the New York Pasteur Institute, February 18, 1890, till October 15, 610 persons who had been bitten by dogs or cats presented themselves to be treated. For 480 of these patients it was demonstrated that the animals were not mad, consequently they were sent back after having their wounds treated. The patients came from all over the continent, most states being represented by one or two cases. When we compare that with the number who receive treatment monthly today we can get an idea of the advances made by science.—J. F., San Antonio, Texas.

Acetylene Light Guards His Garden from Pests

IN A recent issue of POPULAR SCIENCE MONTHLY I read that electric light is being used to combat destructive insects such as the codlin moth. I have used a somewhat similar method since the early nineties of last century. With an acetylene lamp, under which a large dish containing fresh or better soapy water, I have kept cabbages free from the ravages of the cabbage fly, while half a mile away, three large gardens were unable to produce clean cabbages. Sixty cabbages near the light were free from blemish, while some distance away, I was not getting twenty per cent of marketable produce. When the light was not used, the plants were in trouble inside of twenty days. I was using a lantern with kerosene. The radius of its light is not as effective as that of acetylene gas, but it is, in my opinion, sufficient to protect a quarter of an acre. The insect pests are plentiful but the light will effectually keep them in check.—L. G., Sydney, Australia.

Solving These May Give You a Nice, Comfortable Think

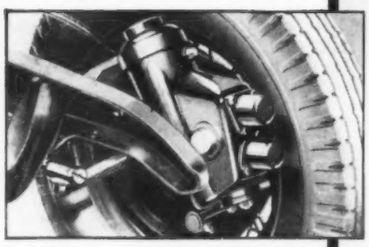
CAN any smart reader give me any inside information on the following six *simple* questions? Einstein's theory in simple language would explain some of them. Was space ever born? Is there life on any other planet than ours? How was the first matter in the universe created? Is space endless? If so how did it get to infinity? If the earth were going to be destroyed by a comet and we on the earth were able to dodge it by going outward from the earth (in a rocket plane, of course) what class of people would we take with us and what people would we leave behind? Why are we? Don't take me too seriously on this.—R. D., Jr., Chicago, Ill.

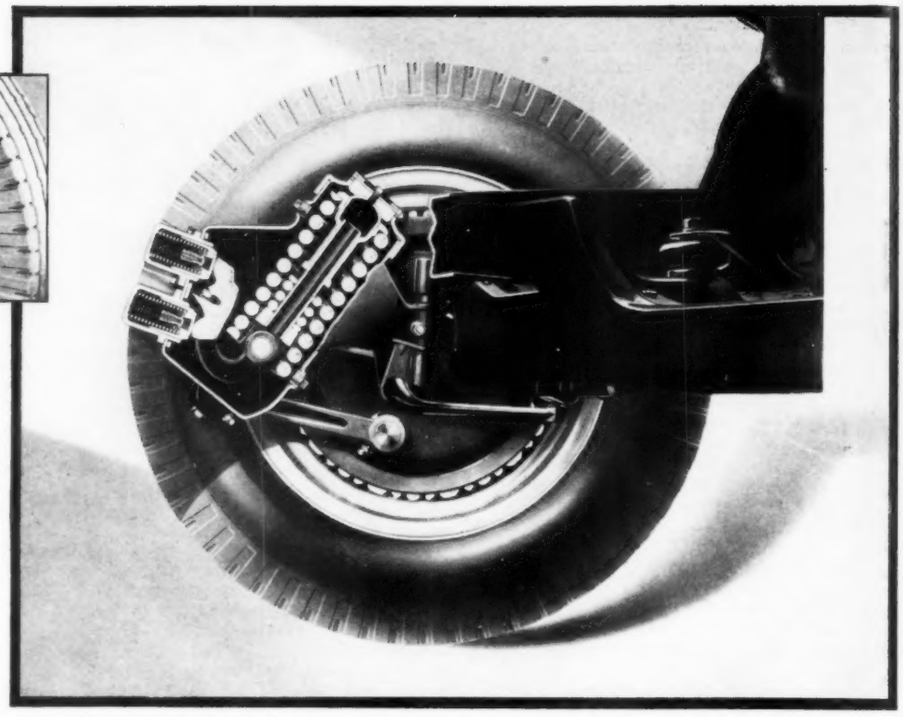
Rocket Plane Might Let Short Ultra-Violet Rays Through

IN POPULAR SCIENCE MONTHLY for January, 1934, I read among other things, the extremely interesting article on "'Lonely Outposts of Science Study Cyclones in the Sun." In the course of that article Dr. Charles G. Abbot is quoted as saying: "This layer of ozone, which is less than half as thick as an ordinary lead pencil, is all that stands between life and death on our planet." Now the question I should like to ask your readers is this: If some one gets a good workable idea for a rocket plane that can be flown through and beyond this ozone layer, would the ultra-violet rays come through at the ruptured point and so reach the earth? If they did so, what effect would they have on human life and how could they be controlled?—A. H. W., Wakefield, Mass.

Why Not Drop the Weight and See for Yourself?

HERE is a question I have been trying to answer for months without results, so I have decided to submit it to your readers with the hope that some one, with more mathematical talent than I have, might come to my rescue. The question is: If a weight of one pound is dropped on a platform scale from a height of one foot, what will the scale register? If the same weight is dropped from a height of two feet what will the scale register? That is, what weight in pounds, not foot pounds, will be represented by the impact in each case?—F. M. B., Honolulu, T. H.

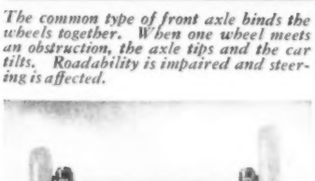




At the right is a cut-away illustration of one of the Knee-Action front wheels of the 1934 Pontiac Straight Eight. The inset above shows the outside appearance of the unit. In Pontiac's system of independent front wheel suspension, the wheel and spindle are carried by a heavy steel arm connected to the frame by a sturdy assembly of soft coiled spring, double-acting shock absorbers, housing and king pin. Cut-away sections show the spring, the actuating arm and the shock absorbers. Note the second coiled spring inside the first. This is stiffer and comes into action only when shocks are severe, to prevent "bumping through." The entire spring assembly operates in a bath of shock absorber fluid and is completely sealed.

How Knee-Action Front Wheels Provide More *Rear* Seat Comfort in the NEW PONTIAC STRAIGHT EIGHT

The common type of front axle binds the wheels together. When one wheel meets an obstruction, the axle tips and the car tilts. Roadability is impaired and steering is affected.



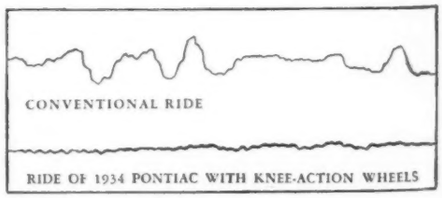
When the front wheel of a new Pontiac meets a bump, the wheel mounts it independently—scarcely disturbing the level of the car. The car holds the road with greater efficiency, and steering is vastly improved.

Here is one of the amazing things about Pontiac's new Knee-Action wheels. They classify as a front-end improvement, but their greatest advantage lies in the gentle, rhythmic ride they provide for rear seat passengers.

In old-fashioned cars the front springs always had to be stiffer than those at the rear in order to hold the axle in place and withstand braking forces. In the new Pontiac, however, the front springs have no structural functions. Consequently, the coiled springs in the Knee-Action front wheels have been made practically as soft as the leaf springs at the rear.

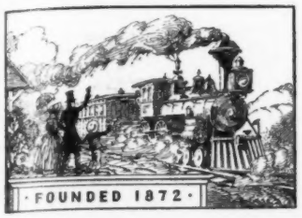
In conventional cars stiff front springs and soft rear springs fight each other in their rate of flexing. The car is bound to pitch and gallop. In the new Pontiac, on the other hand, the soft front springs are tuned to react in unison with the soft springs at the rear. There is no pitching and bobbing. The rear seat does not "rear up" at intervals and throw passengers forward. Instead, the car glides along smoothly, and rear seat passengers enjoy fully as much comfort as those in the front.

Write Pontiac Motor Company, Pontiac, Michigan, for full information on Knee-Action wheels.



The two graphs above were made by a highly sensitive instrument developed at the General Motors Proving Ground. The top graph records the effect of an extremely rough road on the back of a person in the rear seat of a 1933 car. Each peak and valley represents the severity of a jolt. The lower graph is the record made at the same speed, over the same road, with the passenger in the rear seat of a 1934 Pontiac. Note the difference in the severity of the shocks. On the average highway the Pontiac graph line becomes practically straight.

GET A STRAIGHT EIGHT FOR YOUR MONEY!



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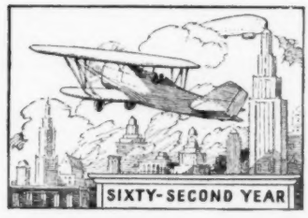
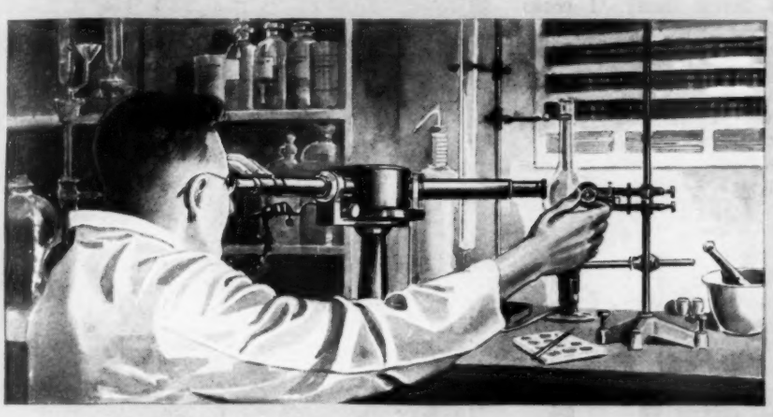
RAYMOND J. BROWN, *Editor*





By
Sterling Gleason

Left, Dr. Kennard in his laboratory using a spectroscope in an analysis of minerals. By this method their chemical contents are disclosed quickly and unerringly. Below, samples of ore to be ground to powder for paint

CHEMISTS DISCOVER

Fortunes *in* Common Minerals

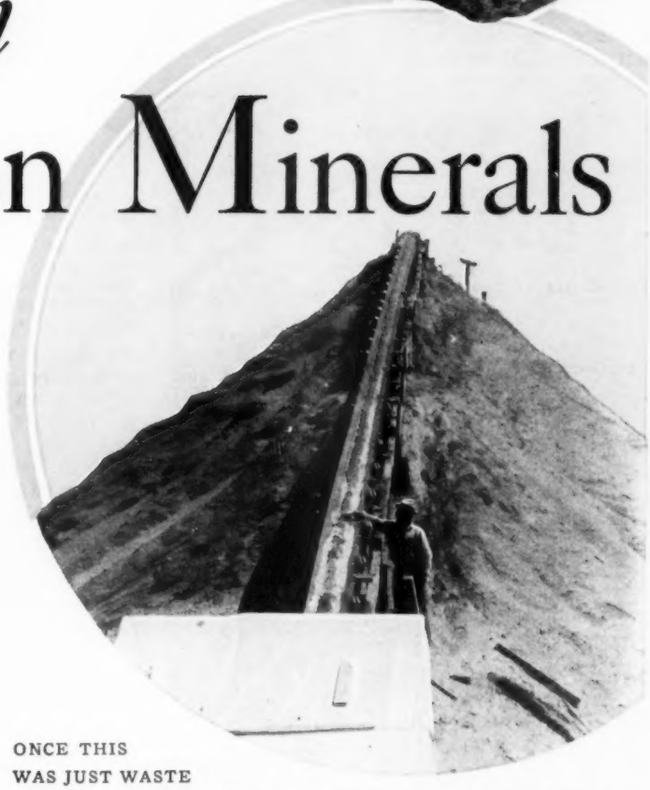
DID you ever drink tea mined from the ground? Or paper your house with fade-proof wallpaper? Or use paint made from rocks?

These amazing uses for common minerals are today making fortunes for prospectors. Big gold strikes like those of '49 are rare; but everyday, ordinary minerals, meeting the demands of industry, are yielding wealth that dwarfs the biggest gold rushes of history.

A bright blue copper ore accumulated for years on the dump of a large mine in the West. Assayers pronounced it too low-grade to smelt. A chemical engineer, attracted by its brilliant hue, picked up samples. Later he bought the whole pile and shipped it to Germany, where he sold it for $300 a ton. Chemists ground it to powder and used its natural color as a non-fading pigment to make paints. In California, a new plant is now grinding refuse ores in ball mills, for the same purpose. Flint pebbles pulverize the rocks into coloring matter. Other brightly colored ores are being used to tint wallpaper that will not fade.

Many prospectors in search of gold turned their pack mules aside to go around a miniature "Hell's Kitchen" in central California, where jets of steam and fumes of sulphur issued from fissures in volcanic rock. Recently this seemingly worthless piece of land came into the hands of a man with imagination. He brought geologists to look the place over. In the steaming crevices, they suspended copper plates. Returning later, they found the copper covered with shiny metallic beads of mercury.

Now steam shovels are stripping away surface rock and laying bare the hidden source of the metal, so the deposit can be mined commercially to meet the needs of a greedy market.



ONCE THIS WAS JUST WASTE

From this formerly worthless by-product of mining, a fortune is now being recovered. Ground to powder, it is used as a pigment in non-fading paint

Another westerner discovered that a peculiar rock on his claim made good tea. He is marketing the mineral as a beverage.

In the high Sierras, a prospector lived in a cabin near an outcropping of yellow-brown mineral. "Have you prospected

this outcrop?" he was asked by a friend.

"Yes, and it's no good," replied the miner. "Runs only thirty cents to the ton in gold. Not worth bothering about."

Later others investigated the claim and had assays made. They found that the mineral was carnotite, a radium-bearing ore. The claim is still being worked.

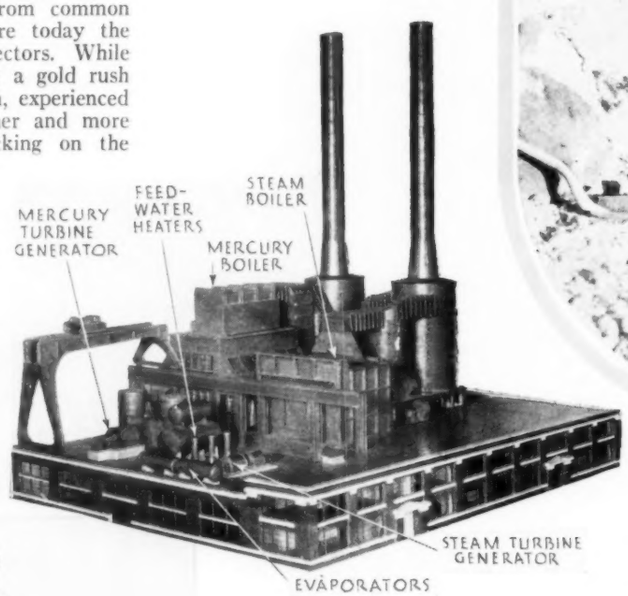
Near one mine where gems were being produced, a soft mineral by-product was thrown on the dump. During the war, when metals of all kind were in great demand, chemists found that it contained caesium—a metal that is sensitive to light. It was badly needed for making photo-electric cells, and brought $100 a pound. Chemists hastened to recover the fortune that had been thrown away, but they were too late. Weathering and washing by rains had done its work, and the valuable caesium was gone forever.

Minerals, all the way from common Epsom salts to radium, are today the object of search by prospectors. While amateur miners are staging a gold rush of a magnitude seldom seen, experienced miners are looking for other and more valuable metals. Back-tracking on the trails of the old-time prospector, they are finding fortunes where he found nothing. Their methods range from simple tests performed with wash pans and portable kits of chemicals, to intricate spectroscopic analyses that require a well-equipped laboratory and instruments costing $5,000 and more. Fortunes are being made, not through lucky discoveries of huge nuggets, but by the application of scientific principles, plus creative imagination.

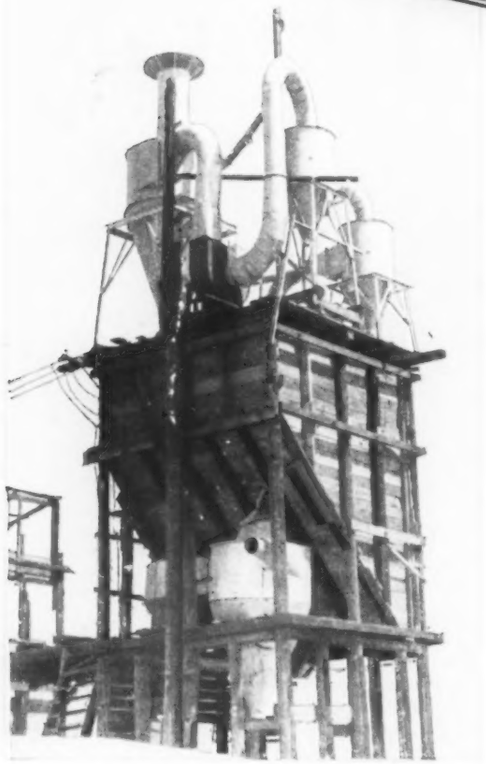
In the laboratories, physicists and chemists are evolving methods of startling importance to the prospector. They are opening up possibilities of fabulous fortunes from rare metals not previously sought by miners. Gold is ridiculously cheap beside many of these mystery metals, that are still unavailable in quantities large enough to meet the needs of industry.

Newest in this field of scientific mineral-finding is the geochemical prospector. His instrument is the spectrograph, the device with which elements were found in the sun before they were known on earth, and which led chemists to look for the rare metals and gases that have now filled in the last gaps in the table of elements.

Lonely prospectors still seek gold and this one-man mine is now being worked in an effort to recover the precious metal from the quartz



Model of mercury-vapor turbine plant which would use one sixth of the country's supply of mercury and thus place this metal in wide demand and increase prices



In this plant a rock, kicked around for years as of no value, is now crushed and from it a good scouring powder is made

In a laboratory at Pomona College, in California, Dr. Theodore G. Kennard is working on new methods for such prospecting. Spectrographic assaying is simple compared with laborious chemical analysis. Ores too complex and difficult to handle, compounds that would take chemists months to analyze and would require hundreds of pounds of samples, may be detected within a few minutes. A pinch of the substance the size of a pinhead is all that is needed. From this the spectrograph makes a snapshot of its structure revealing definitely what metals are present.

Dr. Kennard suggests that prospectors go into the field, gather samples of minerals thought to contain rare metals, and bring or send them to the laboratory. He will then pack a bit of the substance into a little crater in one pole of an electric arc, or make up a solution containing the mineral and allow some of it to dry over the electrode, forming a film.

Under the intense heat of the arc, the mineral is vaporized, giving color to the flame. This light, passing through prisms, is split up into a series of vertical bars, shading gradually through all the colors of the spectrum. Gaseous vapors of the metals present, however, absorb certain colors. Gaps in portions of the spectrum, and bright lines in others, furnish definite proof of the presence or absence of each element. Photographic records are taken. Minutely accurate measurements then determine the wave length of the missing colors, furnishing exact data as to the make-up of the sample.

Rapidly analyzing the series of samples sent him, Dr. Kennard reports back to the prospector, who can then trace the richest samples to their sources, just as a miner follows "float," or surface outcroppings, to the parent lode.

Using this chemical eye, Dr. Kennard can test as many as ten samples within two or three hours, determining the presence of any of forty different elements. Ordinary chemical analysis would require a week or more. For example, to test an ore containing one tenth of one percent of scandium, would take a chemist six

New Treasure Hunters

MYSTERIOUS instruments now reveal wealth hidden in worthless by-products that were once wasted. In this way Science has opened a wide new field to clever treasure hunters

months. He would have to have a bag of ore weighing 100 pounds. With the aid of the spectrograph, Dr. Kennard needs only a half-hour's time and a twenty-milligram sample not much larger than a pinhead.

Quantitative analysis with the spectrograph is the newest phase of geochemical prospecting. Measuring out definite quantities of various minerals, Dr. Kennard makes up a set of standards and measures the brightness of the lines they produce on the photographic plate. By comparing the spectrum of an unknown sample with the standards, he can estimate the occurrence of any element within a thousandth of one percent.

Penetrating still further into the mysteries of the molecule, Dr. Kennard uses ultra-violet light to detect the presence of some minerals. Certain compounds that look white under ordinary light, are colored under the black light. By accurately charting the colors, Dr. Kennard can analyze for these substances.

The rare metals, however, are not the only minerals that offer fortunes to the trained prospector. Like gold, they are found in such small quantities that their extraction requires more machinery and capital than the average miner can supply. Gold itself, although one of the most widely distributed of elements, is rarely profitable for the small hard-rock miner, according to prospectors of the new school.

"We were developing a claim in which gold was located in a stringer of quartz," one small-scale miner told me. "The ore itself was rich, assaying fifty dollars to the ton, but to get it, we had to remove a stratum of very hard granite. After we had spent several months of hard work and had a quantity of ore ready to go to the smelter, we took out a piece of paper and a pencil and did some figuring.

"To get a ton of ore, we had to remove a volume of rock three feet wide, five feet high, and thirty-five feet long—about thirty tons in weight. Actually we were being paid about $1.50 per ton for the hardest of back-breaking pick and shovel work. We could have made more digging a ditch in the city."

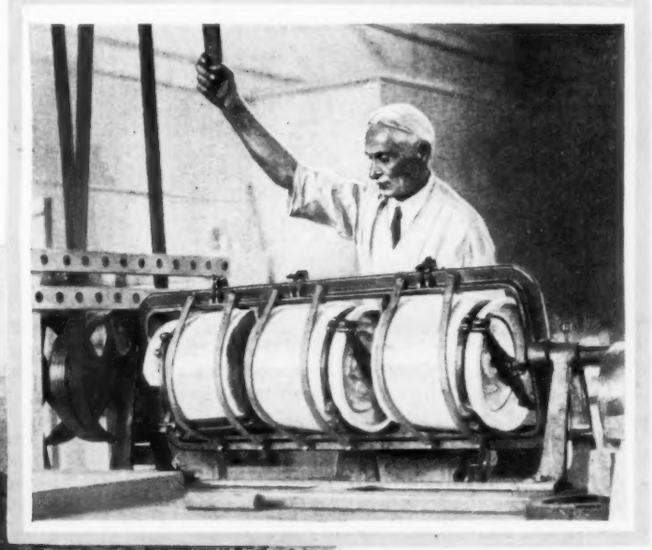
Unlike gold, many minerals are found in huge quantities in an almost pure state. Although they may be worth much less per ounce, their volume makes a strike more valuable than a gold mine. For example, the sodium-impregnated waters of a lake in Texas are soon to yield large quantities of sodium sulphate, a chemical that is used industrially in large amounts. Chemists to whom the problem was put discovered that the chemical can be extracted in a practically pure state simply by freezing the water. The source is thought inexhaustible.

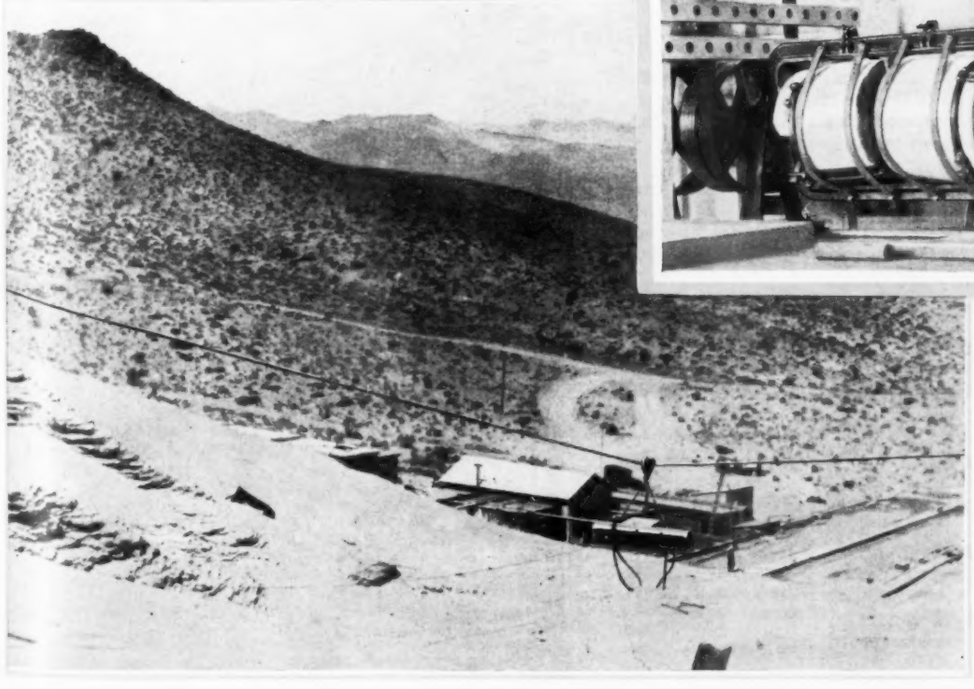
Another mineral occurring in large deposits is diatomaceous earth—a substance consisting of the shells of billions of microscopic water creatures, or diatoms (P.S.M., Aug. '33, p. 34). Their death builds up deposits of a mineral earth, heretofore used chiefly for fine filters in oil refining and other industries. Now another demand has been created. Ground exceedingly fine, this substance makes a face powder that is said to be superior to rice or starch powder.

Pumice, a light, cindery rock ejected in large volume from volcanoes, might seem worthless; yet it is now being ground up and sprayed from airplanes to prevent mildew of the huge cantaloupe fields of Imperial Valley, California. Its countless tiny pores absorb the fumigating gases used, bringing them into contact with the plants. Added to concrete, it is also lending seawater-resisting qualities to a giant new breakwater on the Pacific coast.

A hard rock found in Kern County, California, was passed up for years as valueless, until a man came along who recognized its value to the automobile industry. He bought a whole ranch to get deposits of this rock. Now it is being mined to make spark plugs.

Scientists are setting out to create markets by finding new uses for minerals that are in plentiful supply. For example, millions of tons of oil shale tantalize oil men and chemists. They are too low-grade to be important sources of petroleum at present prices, yet they hold tremendous potential wealth.





In these rotating ball mills, colored ores are ground to powder by flint pebbles imported from Belgium. The pulverized ore forms pigment for paint. At left, part of a vast mountain of mill tailings, now being worked by a dragline that hauls them to a chemical plant for future use

Mechanical Marvels

SPEED BUILDING OF Boulder Dam

MIGHTY DAM RISES SWIFTLY

Photo shows the impressive height reached by Boulder Dam after three year's work. An eight-foot slot, to cool the vast structure, runs its entire length. Pipes carrying water lead into the dam at frequent intervals

To learn how fast the concrete is cooling, engineers take its internal temperature with instruments passed into the pipes

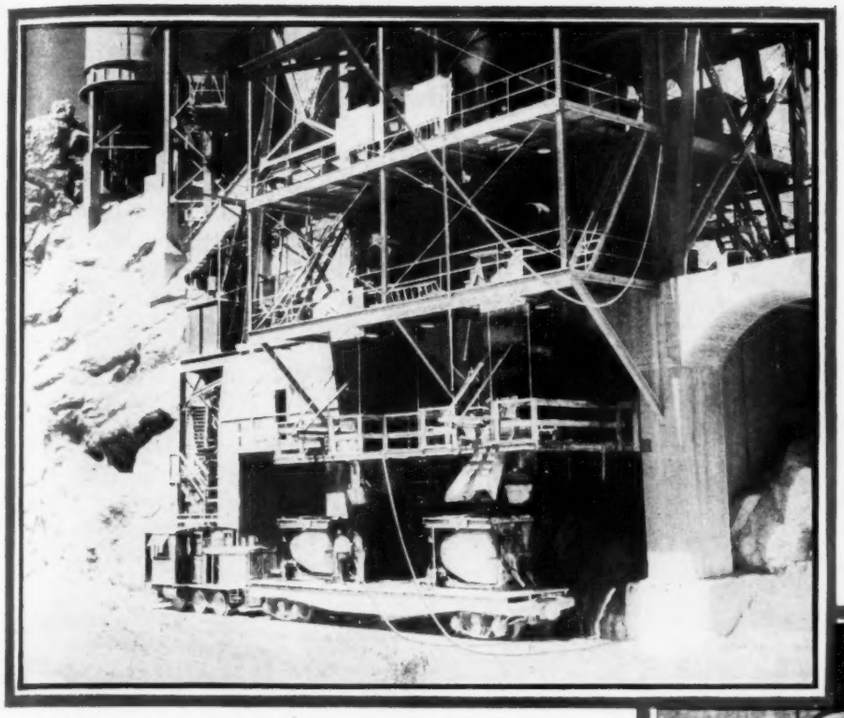
ENGINEERING innovations and scientific short-cuts have already clipped two years from the anticipated construction time of Boulder Dam. Started early in 1931, the $49,000,000 project is being rushed to completion at a pace that shatters all previous records.

I recently visited the spot where this titanic barrier is rising to block the Colorado River, furnish enormous electric power, and add 2,000,000 acres to the tilled area of the country. I spent several days with the engineers in charge and learned of the new methods and mechanical aids they are using.

They took me through "mist rooms" for testing samples. They showed me cork-covered pipes, Big Bertha cement guns, electric thermometers buried in the concrete. They pointed out pipes running like veins through the concrete of the dam, cooling the interior, and they let me see the inner workings of the largest cableway in the world. This six-strand giant, crossing Black Canyon, could support a whole train consisting of a locomotive and a dozen coaches as easily as a department store wire supports a cash carrier!

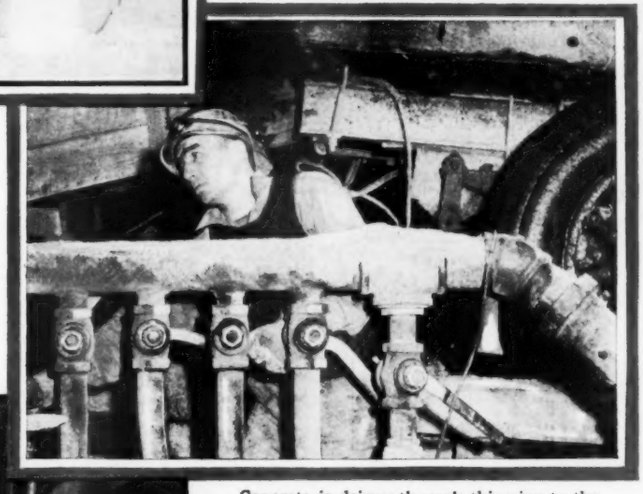
Night and day, every day in the year, 2,750 men work in shifts using the latest equipment in their race to complete this biggest dam in history. When it is finished, it will rise 730 feet above its foundation, higher than a sixty-story building and 325 feet taller than the Owyhee dam of Oregon, previous holder of the world's record for height of a dam.

With the apparatus seen at right, the temperature of the dam is taken daily. Similar records will be made during the structure's entire life



In this plant, at the top of Black Canyon, concrete for the great dam is mixed. Photo shows cars being loaded. From here they run along a railway built on the canyon wall and are dumped where needed

Below, a cone of fresh concrete is being tested to see if it will settle at a uniform rate. This test is made frequently



Concrete is driven through this pipe to the point of operation. The workman is manipulating the valves controlling the air pressure that forces the concrete forward

By Andrew R. Boone

Because concrete is an insulator, sealing heat in and keeping cold out, elaborate precautions have been taken to cool off the interior of the dam. When the crystals of the various oxides, silicates, and carbonates interlock as the concrete sets, the chemical action builds up heat. Without the special cooling equipment built into Boulder dam, it is estimated 125 years would elapse before the interior of its 3,400,000 cubic yards of concrete would be cool. Moreover, the uneven cooling would leave the face of the dam interlaced with cracks and scars.

To overcome these difficulties, the engineers are burying a vast system of pipes in the concrete. Four large cork-covered water mains lead to the wall of concrete for every ten feet of height. They connect with a network of smaller steel tubes which carry refrigerated water through the interior, cooling it as much as forty degrees. The pipes used in this work will reach a total of 662 miles. They would stretch from Baltimore, Md., to Cincinnati, O., with sixty-nine miles of pipe left over. When the pouring is completed, they will be filled with fine concrete and left embedded in the structure.

Each tube cools the concrete around it for a radius of thirty inches and the pipes extend from one side of the dam to the other every five feet. There is no chance in the operation of this cooling system. Several times every day, the engineers stop the flow of water through the different tubes and take the temperatures inside.

Elsewhere throughout the dam, 400 electric thermometers are buried permanently in the concrete. They consist of steel wire coils whose resistance to electric current indicates the heat of the interior. The readings are taken at a central station where an apparatus resembling a telephone switchboard indicates the temperatures at the 400 points. Later on, such readings will allow caretakers of the dam to observe changes in temperature within the great wall during the period of its life.

Another feature of the construction which aids in cooling off the mass of heated concrete is an eight-foot slot extending down the center from top to bottom with recessed sides resembling the teeth of a giant saw. By allowing the concrete on either side to cool as it is poured, it relieves strains and its design is such that when water pressure increases on the upstream side, its teeth will lock so tightly it will be one of the strongest points in the wall.

By erecting the dam in two sections, each composed of numerous blocks tied together for strength, the engineers have also speeded up the cooling time of the structure. More than any other single aid, these steps, taken to insure quick cooling, enable the builders to rush the construction of the dam with safety.

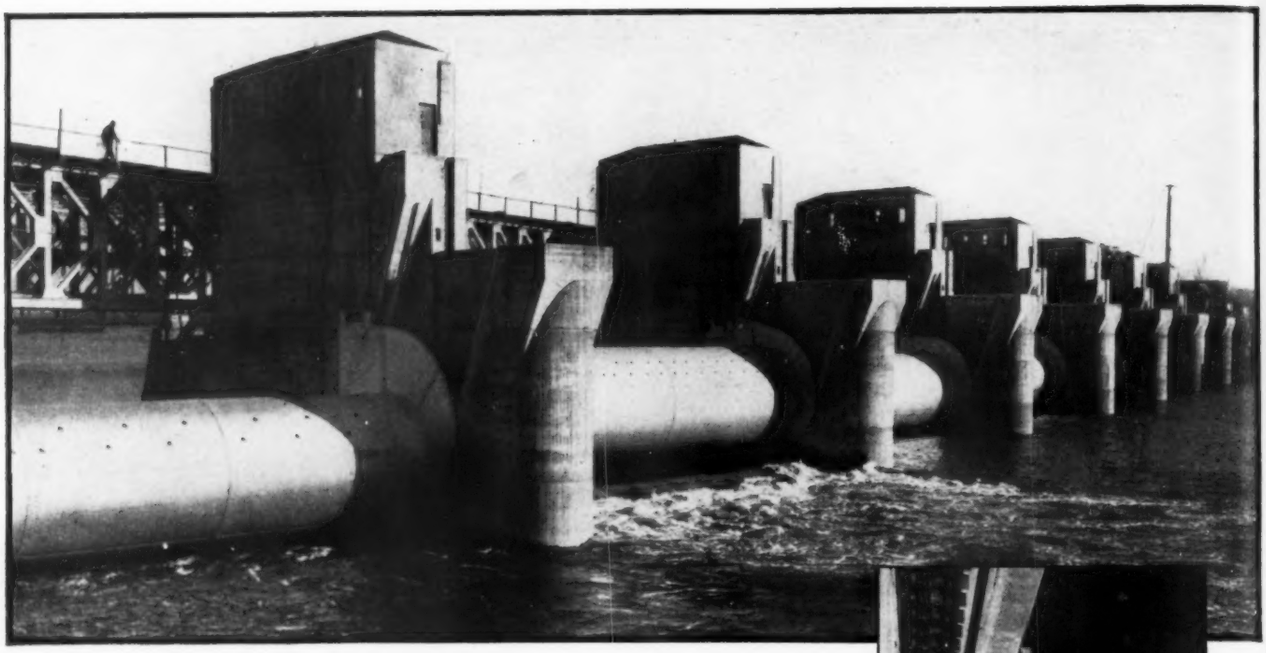
TESTING CONCRETE FOR DAM

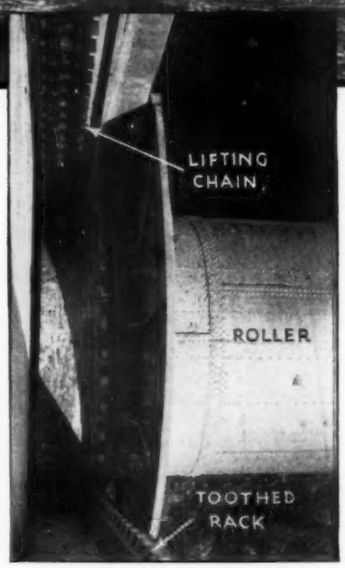
Cylinders of concrete, cast from the regular product, are crushed in this machine as a test of the material being used

However, a multitude of other activities which go on behind the scenes hasten the work of construction and avoid costly mistakes such as the pouring of concrete with insufficient strength.

Every hour, for example, experts make "slump" tests. From the mixers, they take buckets of fresh concrete, remove the larger rocks and place a batch in a metal cone. Suddenly, the operator lifts the cone from around the sample and then measures the slump, or distance it settles. This simple procedure reveals instantly whether the material going into the dam has adequate body.

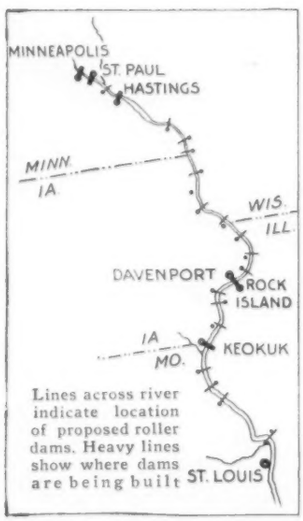
Again, government engineers in the *(Continued on page 109)*





At top, roller dam in the Mississippi. Above, close-up of the lifting mechanism that moves the rolling dam

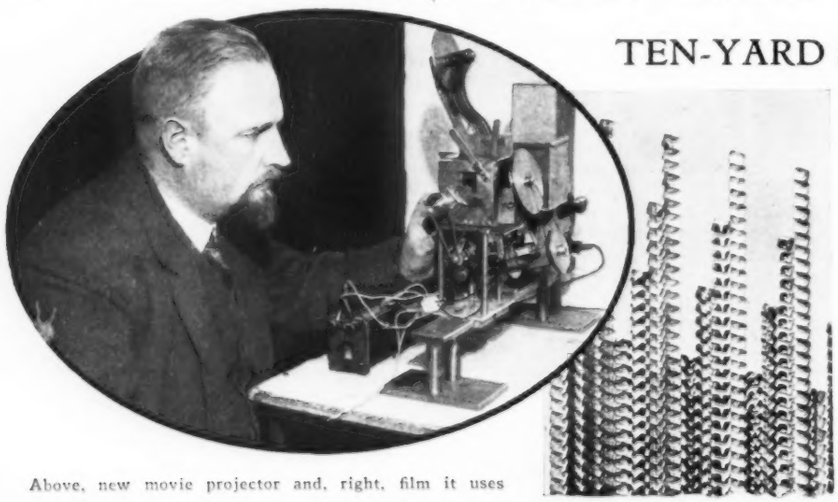
Dam That Rolls Up to Control Mississippi



Lines across river indicate location of proposed roller dams. Heavy lines show where dams are being built

A DAM that rolls out of the way when it is not needed is nearing completion at Davenport, Iowa. Largest of its type ever built, it will set the style for twenty-six equally curious structures, in a monster engineering project to conserve the flood waters of the Mississippi River.

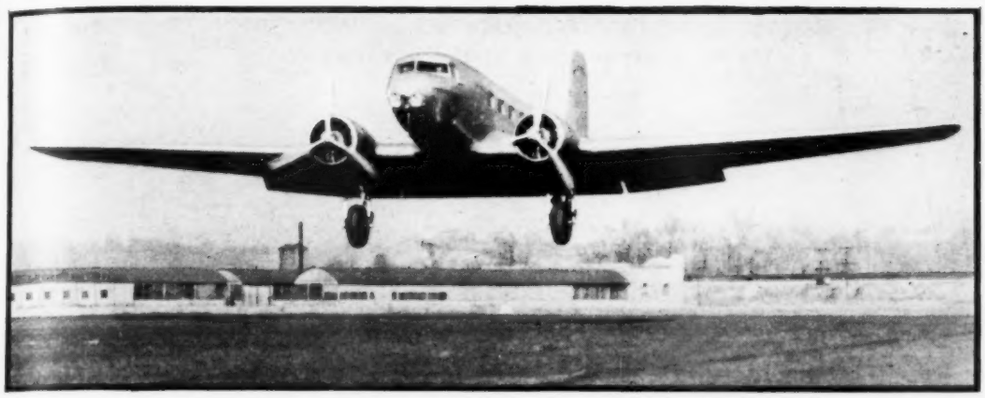
These dams will meter out the waters of the Mississippi as necessary. Along its upper length, they will maintain, as a minimum, the nine-foot level necessary to float barges of 3,000-ton capacity. To do this economically and effectively, a special type of dam is required, the final design of which will depend on tests of the Davenport structure. Eleven 100-foot cylinders of steel, each one twenty-six feet in diameter, now regulate the flow of the river at Davenport. When submerged and filled with water, the hollow cylinders obstruct the river and raise the level behind the dam. Each one can be emptied of water and drawn clear of the stream in six minutes. Drawn by lifting chains, it rolls up a track provided by inclined, toothed racks on each abutting pier, which engage gears at the ends of the cylinder itself. Electric motors of only twenty-five horsepower handle the rollers. Current for the motors is obtained by a generating plant that uses the head of water at the dam, thus compelling the river itself to furnish the energy that moves the strange dam and controls the mighty Mississippi.



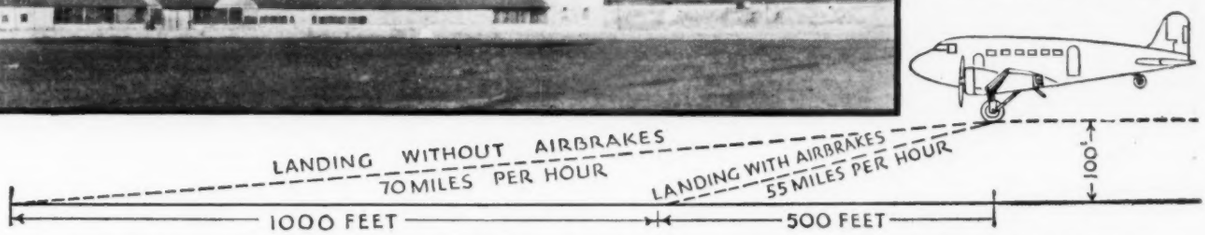
Above, new movie projector and, right, film it uses

TEN-YARD STRIP OF FILM TAKES 6,000 PICTURES

BY DEVISING a way to crowd more than 6,000 pictures on a ten-yard strip of motion picture film, a German inventor lays claim to outstanding economy in movie making. The pictures are taken in eighteen parallel strips along the film, which runs alternately forward and backward, on a slant, through the camera and projector. The individual pictures are also taken on a slant to compensate for this, so that they will appear level on the screen. Each foot of the new film is equivalent to twenty feet of standard film, and, because of its greater width, is declared less subject to breakage and so further reduces the cost.



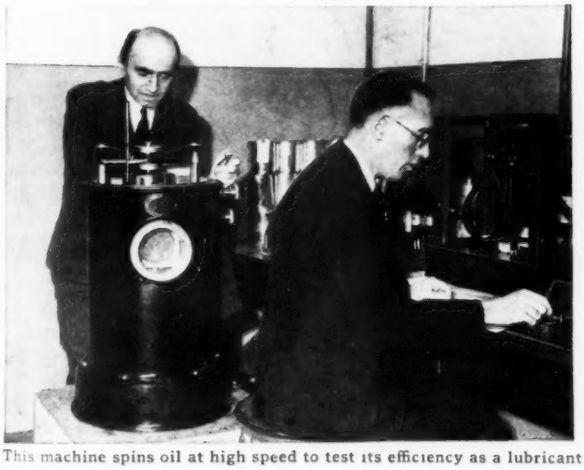
At left, passenger transport plane making a landing in a small field with the aid of its air brakes. Below diagram shows how air brakes decrease required landing space by cutting the speed at which a big plane can come down to the earth



AIR BRAKES ON PASSENGER PLANES CUT LANDING SPACE

AIR brakes, already tried out successfully on a few private aircraft, enter the field of passenger transport for the first time with their installation in a fleet of new transcontinental air liners. The brakes consist of special flaps, mounted on the trailing edge of an airplane wing. They are depressed in landing and reduce the machine's speed so much as to decrease the required landing space by two-thirds. Thus they end a dilemma of aviation engineers, whose problem was to design faster airplanes without increasing their landing speed or extending the space required for a safe landing. As shown in the accompanying diagram, a plane equipped with the brakes can roar up to an airport at cruising speed and then abruptly sit down.

SPIN OIL AT HIGH SPEED TO TEST IT



This machine spins oil at high speed to test its efficiency as a lubricant

OUTSTANDING problems of lubrication may be solved by a new machine, first of its kind, that tests and grades oil by whirling it on metal bands at speed up to 22,000 revolutions a minute. By weighing the bands before and after the test, as shown at left, engineers can gage the ability of the oil to penetrate and cling to metal. The first research task of the machine will be to solve lubrication problems involved in the operation of railway transportation.

Above, subway car insulated to keep out all noise. In ceiling are ventilation ducts. In oval, chains between cars covered with rubber to deaden the noise

ELECTRIC EYE OPENS RAILWAY STATION DOORS

FOLLOWING successful tests of a single installation, six main doorways of the Pennsylvania railroad terminal in New York City are to be equipped with magic doors that open without the touch of a human hand when anyone approaches them. Operated by a light-sensitive electric eye, the new type of door has proved a boon, during its initial trial, to elderly persons and porters laden with bundles. This is believed to be the first application in a railway station of doors opened by the operation of photo-electric cells, although similar installations have been made elsewhere.

Railway station door opens itself at pedestrian's approach

SOUNDPROOF CAR MAKES NOISY SUBWAY QUIET

SUBWAY riders in New York City recently enjoyed the novelty of silent travel when a soundproof car of new design received its first service tests. Insulation shuts out the roar, while five air-conditioning ducts in the ceiling take the place of open windows to bring fresh air to passengers. Even the clank of hanging chains between the cars is suppressed by encasing them in rubber tubing. To demonstrate the efficiency of the car the windows were opened during the trials and the familiar deafening noise was heard.

BIGGEST STONE MIRROR USED BY ANCIENT RACE

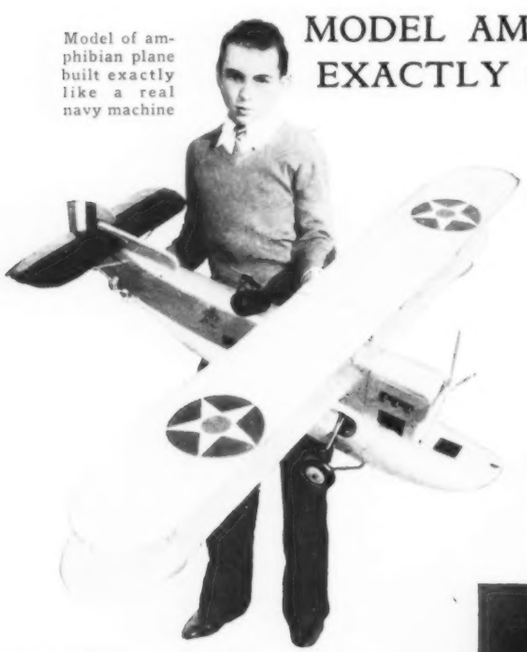
LONG before silvered glass was heard of, natives of Central America admired their reflections in mirrors made of stone. One of the largest ever found, constituting a rare archaeological discovery, now rests in the University of Pennsylvania Museum. Polished fragments of hematite, a lustrous red mineral, were joined by its ancient craftsman in a disk-shaped mosaic, as shown above to provide a hand mirror.

NEW VEHICLE IS HALF AUTO AND HALF PLANE

Half auto and half plane, the front wheel of this new vehicle leaves the ground as machine hits high speed

HALF automobile and half airplane in appearance, a hybrid vehicle called the "roadplane" has been invented by Prof. T. Edward Moodie, aeronautical expert at the Georgia School of Technology, who is trying out his odd creation in service tests. When the car attains a fair rate of speed, the driver operates an elevator control that lifts the small front wheel from the ground. The car then runs on the two main wheels while air rudders steer it, like an airplane taxiing across a landing field. As the car comes to a stop, the front wheel settles to the ground. Controls resembling those now used on an airplane are supplied to guide the unusual vehicle.

MODEL AMPHIBIAN PLANE EXACTLY LIKE ORIGINAL



Model of amphibian plane built exactly like a real navy machine

ACCURATELY built to scale by its nineteen-year-old maker, a Navy amphibian plane model just completed by Ben Hammer of Pasadena, Calif., is declared by experts to be one of the most nearly perfect of its kind. The miniature machine is patterned after the Loening type in government use, and is powered with a three-quarter-horsepower motor. Its fittings are complete, even to retractable landing gear and machine guns. The illustration at left shows the amphibian model in the hands of its young builder, who is building airplane models for movie studios.

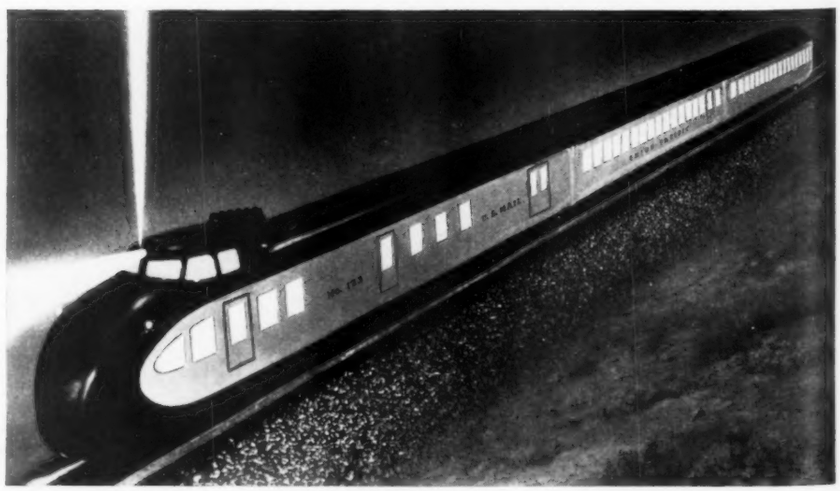
WIND-POWERED LAMP LIGHTS UP PARACHUTE

Parachute jumper wearing his lamp that is powered by wind

TO GUIDE him to a safe landing in night descents, a British parachute jumper successfully uses an electric lamp strapped to his waist, for which current is provided by a wind-driven generator on his helmet. A diminutive two-bladed propeller whirls the generator during his long drop. The use of this apparatus avoids the necessity of carrying heavy batteries that would prove an encumbrance and an undesirable added weight.

VERTICAL HEADLIGHT ON STREAMLINED TRAIN

WHEN the 110-mile-an-hour streamlined train, now nearing completion in a Chicago factory, is placed in service by the Union Pacific Railroad, its locomotive will be the first to carry a vertical headlight. Engineers decided to install the perpendicular projector, as well as one of the conventional horizontal type, as a safety feature, since the sky-pointing beam is expected to attract the attention of motorists and pedestrians as the train rushes toward a grade crossing. In addition, the new headlight is expected to prove a helpful beacon to aviators skimming along the route of the all-aluminum train.



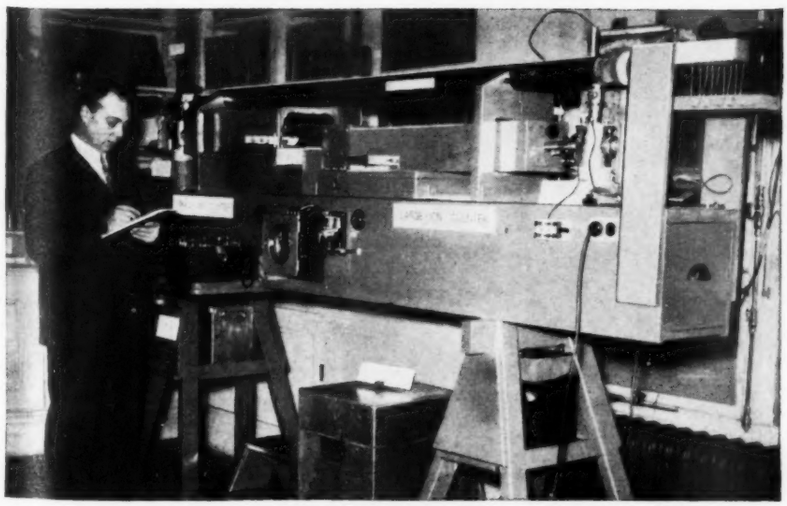
Vertical headlight on an all-aluminum 110-mile-an-hour train warns motorists of its approach

BIBLE, 1600 YEARS OLD, EXHIBITED IN MUSEUM

GUARDED by armed detectives, the world's most valuable manuscript, shown above, has just been placed on public view at the British Museum in London, England. The book is the Codex Sinaiticus, one of the two oldest Bibles in existence, which was penned in the fourth century and discovered centuries later in a monastery on Mt. Sinai, in Egypt. Later owned by Russia, it was recently purchased by Great Britain for £100,000, about half a million dollars. Its Greek text and vellum pages are reported still in excellent condition. The book takes the last part of its name from its place of discovery, while a "codex" is a manuscript of separate, bound leaves, as distinguished from a roll or continuous sheet of material used by scribes of the same era.

NEW MACHINE COUNTS IONS IN ATMOSPHERE

TO AID scientists now studying the effect electricity in the air has on human beings (P. S. M., Feb., '34, p. 11), a new tool has been developed by Carnegie Institution experts. The instrument, known as an ion counter, measures the quantity of electrically charged particles in a given volume of air. Its use shows that floating soot particles diminish the electrification of the atmosphere.



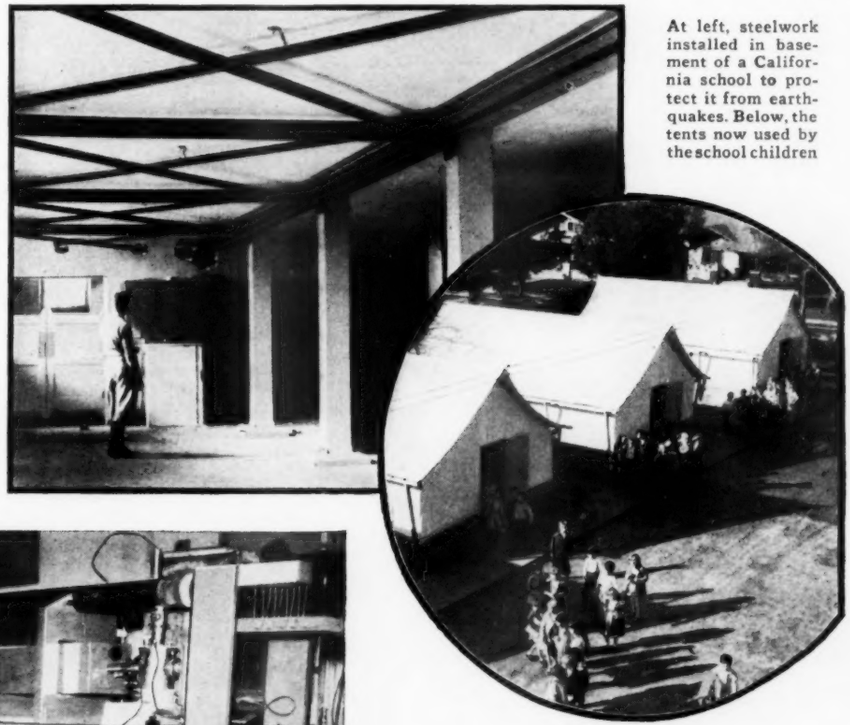
New machine used to count electrified particles in a given volume of air

HANDMADE CANDLES WORK OF ONE MAN

CALLED the last of the candle makers, Jose Herrera, of Los Angeles, preserves the old art of fashioning wax candles by hand. A rotating iron hoop in his workshop supports the hanging wicks, down which he pours molten wax from a hand ladle. Each candle is revolved by hand meanwhile, thus spreading the wax evenly. Sometimes the candles are decorated with intricate designs of colored beeswax, and perfumed with floral odors. The largest candles Herrera makes are suspended from the roof of his tiny shop. The biggest he makes would burn for ten years.

Over wicks suspended from the iron hoop melted wax is poured in making candles by hand. This is the last shop to make candles this way

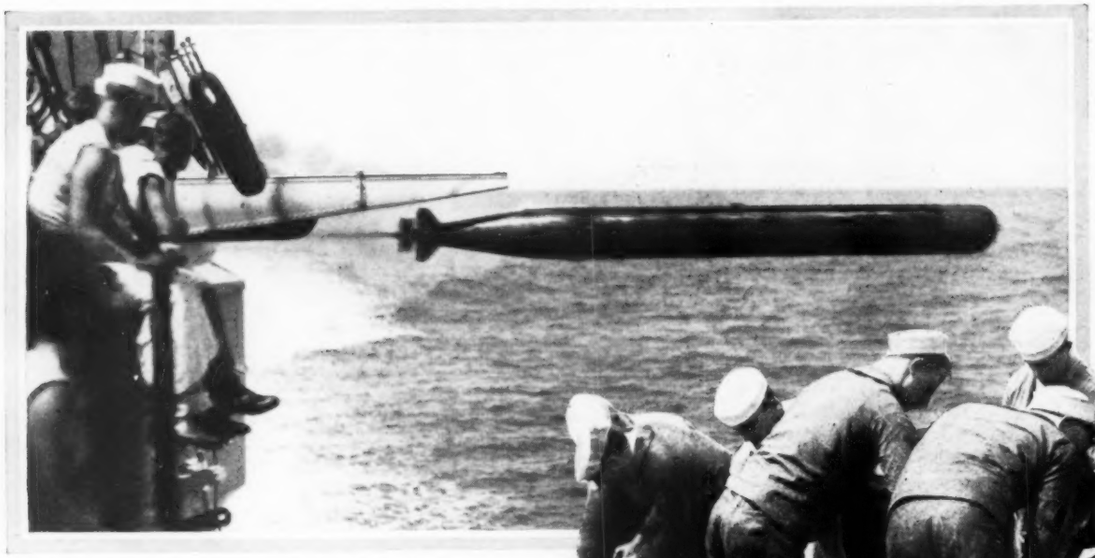
QUAKE-PROOF SCHOOLS FOR CALIFORNIA



At left, steelwork installed in basement of a California school to protect it from earthquakes. Below, the tents now used by the school children

MORE than 3,000 tent-house classrooms will house school children of Los Angeles, Calif., during the remodeling of California school buildings found inadequately quake-proof in surveys just concluded. This precaution is taken to forestall possible danger during another earthquake like that of last March. Steelwork is being placed in the brick structures to prevent roofs from caving in, and walls are being strengthened, at a total estimated cost of $25,000,000. Underwriters declare that deaths might have been numbered by thousands if last year's quake had occurred during school hours.

Dummy Torpedoes Shot in Practice

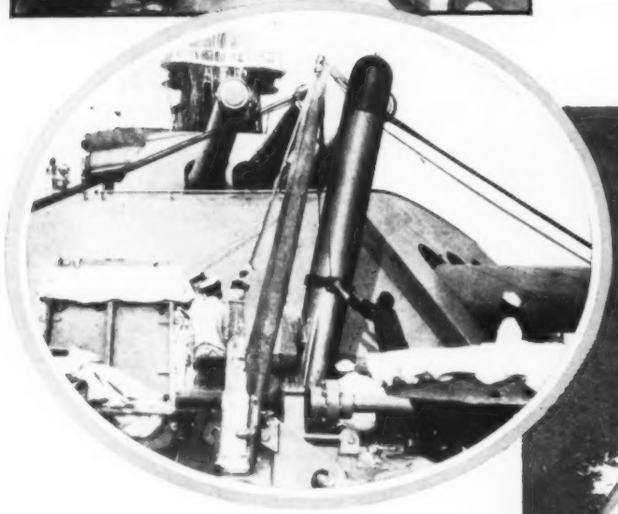


Fired by compressed air from a tube on deck of a warship, the speeding torpedo is shown here just before it drops into the water, after which it is self-propelled

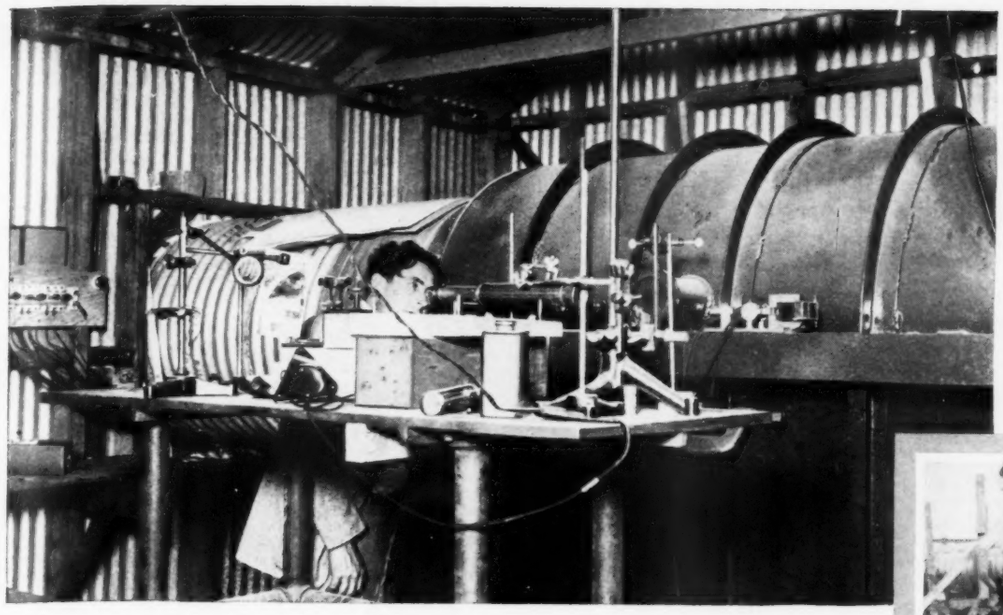
Below, propellers, seen at right end of torpedo, are driven by compressed air. A gyroscope inside the torpedo steadies and steers it so that it is held true to its course

At left, removing the torch case of a torpedo. In it are chemicals that burn on contact with water and emit smoke that marks course of released torpedo

TAKEN during recent maneuvers of the U. S. Navy off San Pedro, Calif., the striking photographs reproduced on this page reveal the drama of naval torpedo practice. Each one of these twenty-two-foot missiles costs the government about $10,000, and therefore in practice its charge of deadly explosive is removed. A torch case, substituted in its place, emits smoke and flame so that the torpedo can be traced and recovered after firing. The costly pieces of mechanism are driven by compressed air, steered by a gyroscope, and move twenty-five to fifty miles an hour.



Above, a torpedo is brought back to the ship from which it was fired and lowered into the hold for future use. At right, recovering a torpedo after its driving charge has been exhausted. This is the duty of the men in the small boat. They are shown rigging a hoist so torpedo can be raised to deck



At left, making one of the thousands of observations that tested the speed of light. A beam of light was flashed up and down the tube by means of whirling mirrors. In the two photos below are shown first, an emergency check-up to be certain of the length of the tube and a surveyor running a line straight through a house

Mysterious Variation in Speed of Light

DOES the speed of light, long believed one of the few constant things in the universe, vary after all? Experimenters who have just completed the three-year task of timing a light beam in a mile-long vacuum tube at Pasadena, Calif., are wondering if this can be true. Thousands of the most careful measurements, taken with every scientific precaution, do not agree.

Eight years ago the late Prof. A. A. Michelson, renowned physicist, flashed light between mirrors on mountain peaks twenty-two miles apart and clocked it at 186,284 miles a second. To obtain a more nearly accurate figure, he directed the construction of a tube three feet in diameter and a mile long at Pasadena, so that the speed of light could be measured in a vacuum. After his death, Dr. Francis G. Pease of the Carnegie Institution, and Fred Pearson, of the University of Chicago, carried on the task of making the observations.

A year ago, as first reported in this magazine (P.S.M., Dec., '32, p. 36), the measurements showed such marked discrepancy with previous results as to occasion a distress call to the U. S. Coast and Geodetic Survey, whose surveyors repeatedly remeasured the length of the tube and found no error there. More recent speed-of-light observations only emphasized the apparent erratic behavior of the light beam that the scientists were attempting to clock. On some days it seemed to travel faster than others, by as much as twelve miles a second. Its speed seemed to vary with the season and also in a mysterious shorter cycle lasting about two weeks. Finally the scientists ended by taking an average of all the readings, which has just been announced as 186,271 miles a second.

That the speed of light varies, as the tests suggest, is not the only proposed explanation. Another is that recurrent tides in the earth, not hitherto known to occur, periodically shifted the position of the recording instruments.

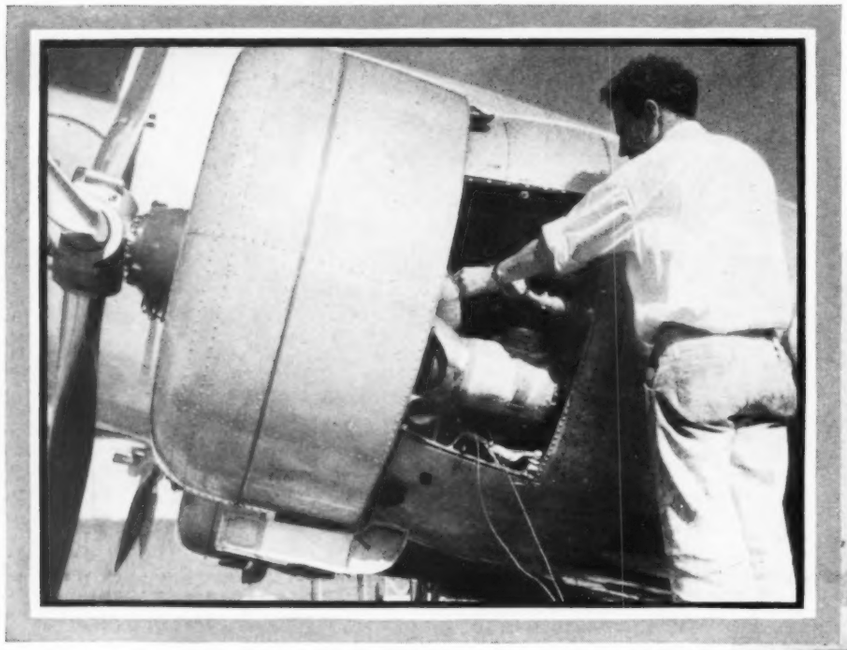
APPARATUS USED IN LIGHT SPEED TESTS

Left, above, the mile-long vacuum tube that was used in measuring the speed of light. Upper right, using a surveyor's instrument to install, accurately, the tube's receiving end

Breath-Taking Stunts Test

Delicate Instruments Help Pilots Find Factor of

By EDMUND T. ALLEN
Famous Test Pilot



Shown in the nose of the plane above is a boiler that holds a gallon of water. Heated by the exhaust, it provides enough steam to heat the plane's cabin. At right, flap on rudder, set so plane would fly in a circle

TEN thousand feet above the Pacific off the southern California coast, I was flying the large transport, making ready for the crucial test. The two engineers and I wore parachutes, for I was about to stick the heavily loaded plane down in a terrific dive, to pull nearly nine tons of airplane and lead bars up to the point where the ship theoretically would begin to pull apart.

No airplane in commercial service ever approaches such a severe stress, but during 150 test flights I made recently in preparing the first of a new series of airliners for public use, we turned it into a flying laboratory and subjected it to unique tests unknown a year ago.

I have flown military airplanes earthward at 400 miles an hour as I observed quivering instruments recording the stresses and strains. Except for military purposes, airplanes do not perform these terrific maneuvers. Yet for the safety of passengers who later will fly in these liners of the air, we put the big planes through tests that cannot be applied in wind tunnels and which the ships never again will be called upon to face.

As I shoved the wheel forward and stuck the transport down in the dive an engineer sat ready with an ordinary pair of weighing scales to measure the force I would apply to the wheel at the instant we began to pull out of the dive.

Down we went as I shoved mightily on the wheel. Quickly the needle on the airspeed meter climbed up to 250 miles an hour. Beyond that speed we could not go for I do not possess enough strength to hold the controls against the terrific pressure of the rushing air.

I shoved with a force of 150 pounds against the wheel to hold the plane in the dive. When we had dropped 2,000 feet I reversed the process and pulled. At the same moment my assistant in the cockpit slipped a spring over the steering post and in a few seconds recorded my pull—150 pounds.

Thus I applied almost instantly a change of force approximating 300 pounds to pull the transport out of the dive, and we knew precisely how hard pilots on the airlines must tug at their wheels to recover from a dive at high speeds.

Nor did we stop with measuring forces on the controls. Hidden beneath the floor boards of the passengers' cabin at the center of gravity, was a small instrument containing a floating spring whose pen makes scraggly marks on smoked glass during the pull out. The extra load deflects the spring in this recording accelerometer.

As I pulled the ship up from its earthward flight, as the record indicated later, it overcame a force equalling three and one-fourth times the pull of gravity, which meant that the 17,500 pounds, which it weighed in normal flight, suddenly jumped up to nearly 60,000. Yet the plane came through the ordeal without loosening a rivet or straining the wings.

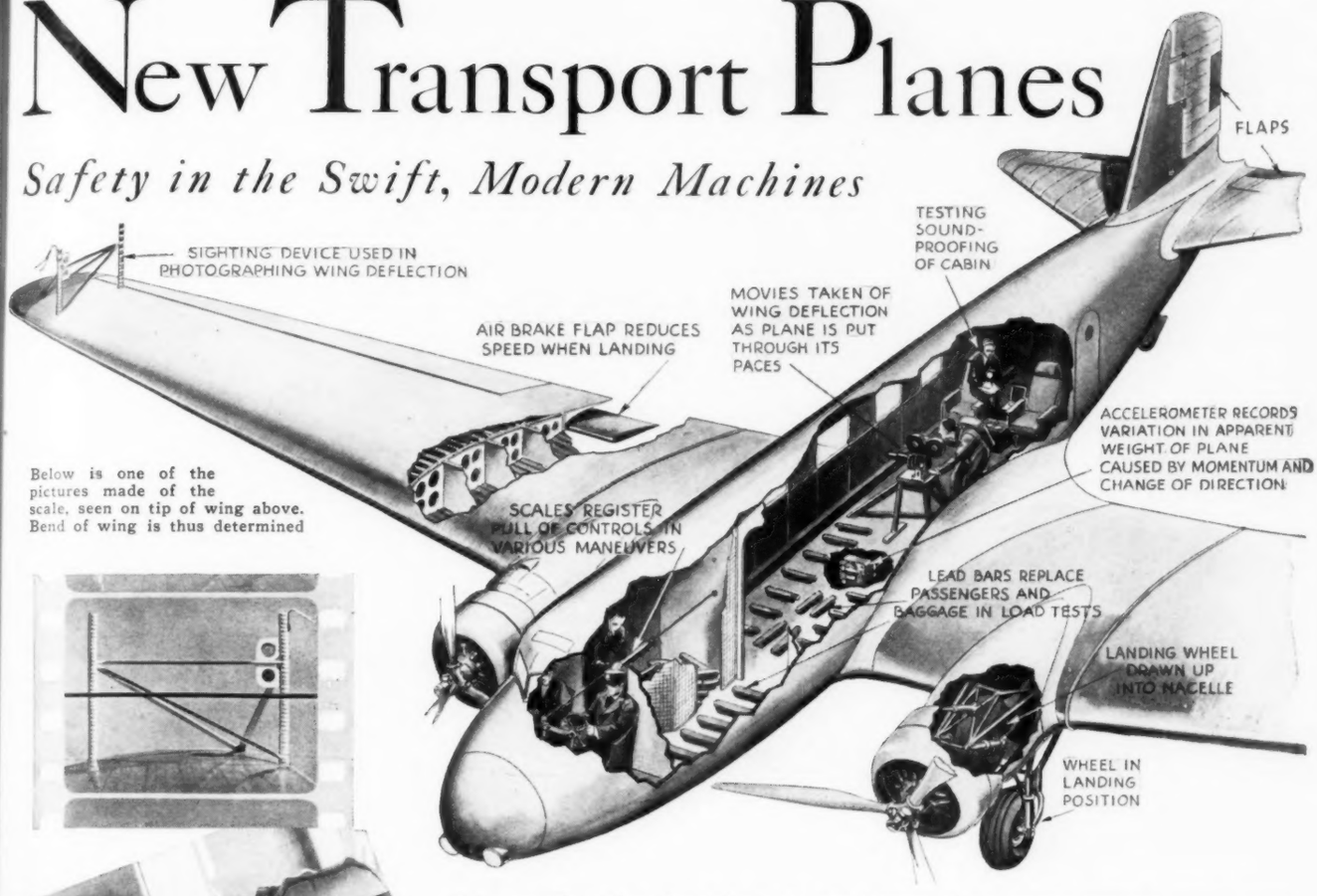
Everyone knows that the wings "bend" in varying amounts as a plane rides through the air. I heard recently of a glider whose wing tips moved up and down through an arc measuring nearly eight feet, yet the craft is considered quite safe for flying. Airplane wings do not deflect more than a few inches normally, and to measure this deflection by observation only is impossible.

For that reason we carried into the air a motion picture camera, its telephoto lens pointed out a window of the passengers' cabin, looking straight out over the wing and focused on a fencelike device bolted thirty-five feet distant tightly to the wing. This consisted of two upright, streamlined, hollow metal tubes on which had been marked inches and fractions thereof to help our measurements.

We focused the center of the camera midway between top and bottom of the scales. Making sure the camera was bolted

New Transport Planes

Safety in the Swift, Modern Machines


FLAPS
TESTING SOUND-PROOFING OF CABIN
SIGHTING DEVICE USED IN PHOTOGRAPHING WING DEFLECTION
MOVIES TAKEN OF WING DEFLECTION AS PLANE IS PUT THROUGH ITS PACES
AIR BRAKE FLAP REDUCES SPEED WHEN LANDING
ACCELEROMETER RECORDS VARIATION IN APPARENT WEIGHT OF PLANE CAUSED BY MOMENTUM AND CHANGE OF DIRECTION
SCALES REGISTER PULL OF CONTROLS IN VARIOUS MANEUVERS
LEAD BARS REPLACE PASSENGERS AND BAGGAGE IN LOAD TESTS
LANDING WHEEL DRAWN UP INTO NACELLE
WHEEL IN LANDING POSITION

Below is one of the pictures made of the scale, seen on tip of wing above. Bend of wing is thus determined

Cut away illustration above shows the new features of the present transport planes, along with the instruments that are installed and used for the purpose of recording the results of tests

CABIN MADE QUIET

Delicate microphones were used to record sounds and these records helped designers end noise

This plane was landed with the wheels fully retracted and the only damage was the bent propellers

Vibration areas inside the cabin are broken up as shown above. In this way, noise has been eliminated. At right, cabin door that is fastened at four points to keep the big new airliners noiseless

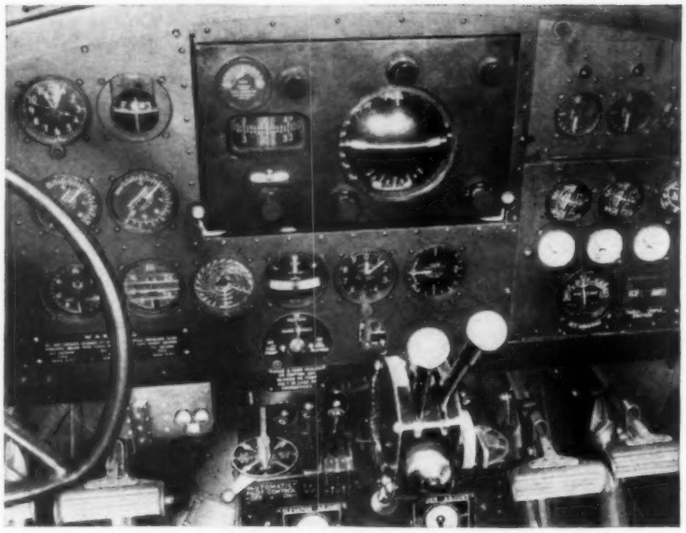
tightly to the floor, off we went and as the film rolled past the lens, I put the ship through the paces which I knew would bring added strain to the wings. Later we had only to examine individual frames of the film to read instantly the deflection, up or down, in inches. Nothing more accurate could be devised to measure during flight the give of an airplane wing.

But the forces developed during various maneuvers interest us only little more than the controllability of these high-speed transports. A year ago planes plying the air lanes between the Atlantic and Pacific flew only 115 miles an hour. The flying laboratory which I piloted through these intricate tests cruises at 190 miles an hour. Often we roared above our testing grounds faster than 200 miles an hour. Eighty miles an hour added to the speed of transport planes in a single year's development.

Like the modern automobile, these ships must have a high degree of roadability. Pilots have too many duties to perform to wear themselves out fighting the controls. Now we measure not only the forces required to move the ailerons, rudder, and elevator, as I have described to you, but we also determine

accurately the positions of the various controls and the resulting attitude of the plane.

In my earlier years of flying, I looked on a flight as a single operation. I merely flew the airplane from a standing start into the air and back down to a landing. Now I realize that the take off, the initial climb, the climb at higher altitudes, level flight, and landing are separate and highly individualized undertakings.



Instruments cover the dashboard of the newest and fastest transport airliners

I HAVE on my dashboard during tests a remarkable little instrument known as a position indicator. Its three dials record instantly and accurately the angle made between the elevator and the stabilizer, the rudder and the fin, and the ailerons and the wings.

We must now know, as the passenger ships dash through the sky nearly twice as fast as did their predecessors, how far the pilot must move his wheel to change the ship's position in flight, how hard he pulls and what happens.

These new ships possess stability to a high degree. That is, we can put them in a climb, a dive, a side slip, or in level flight and fly them hands off for a long period of time. By ingenious flaps attached to the control surfaces, I may change the ship's balance while flying high above the earth and can pull it out of that balance only by a sturdy tug at the wheel.

Also we actually can measure a plane's stability, which, briefly, means its tendency to return to its balanced position, whether a dive, climb, or level flight. This requires expert piloting, a hand having the touch of a feather and the strength of a boxer. The other day I took off in the big Douglas transport, the two engines pouring 1,400 horsepower into the three-bladed propellers, ready to test the ship for diving balance.

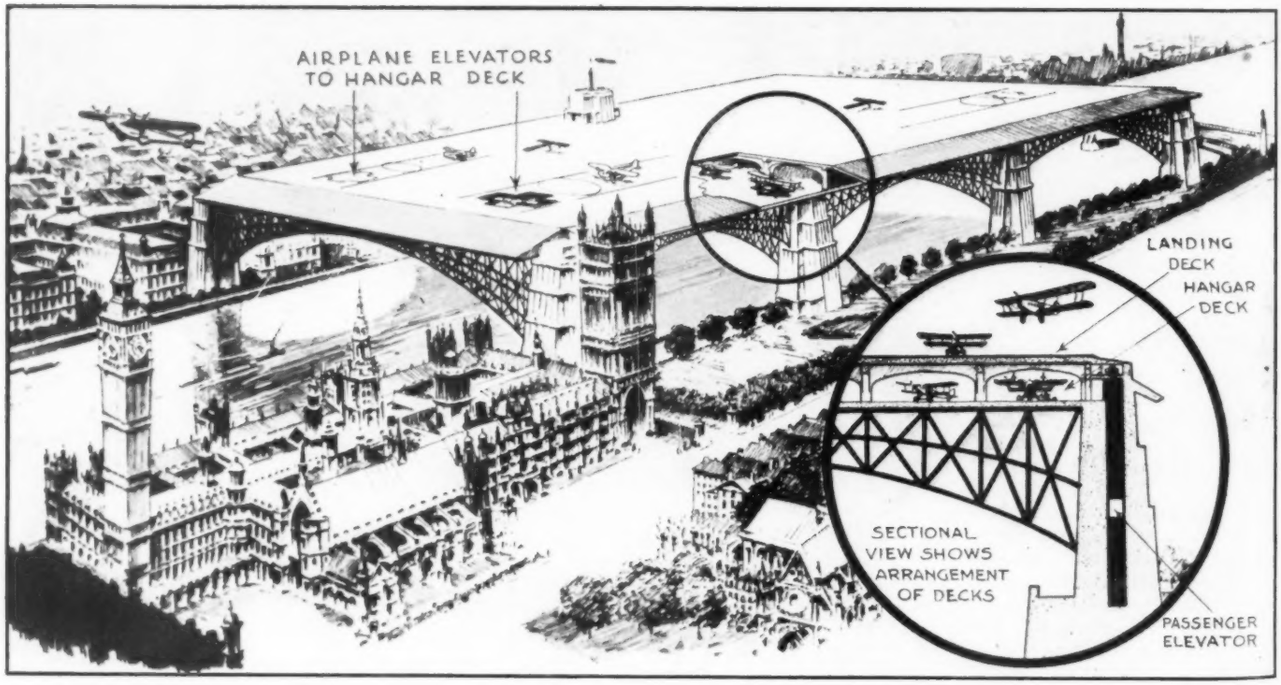
Dive here does not mean, as in the case of fighting planes, a screaming drop through the heavens, but rather a mild glide with the nose a few degrees below level flight. After reaching 10,000 feet I set the elevator flap for a five-degree glide. We were at the moment flying 220 miles an hour and descending 100 feet a minute.

Thus we were balanced, even though diving. But how well was the ship balanced? I pushed forward on the wheel, until the air speed indicator registered 240 miles an hour. Having attained this added speed, I released the controls completely. Gradually the plane began to return to its previous glide, oscillating back and forth like a heavy pendulum. Our speed varied from 240 miles an hour to 200, as it swung slowly up in a climb; fifty seconds later we picked up 230 as it dove again; back to 210 . . . then 225 . . . back to 215 . . . 220. And there we continued our earlier line of flight.

WE EVEN measured the power exerted by the tiny flap as the 220-mile gale flew past its sleek metal surfaces. My arms exerted a push of forty pounds against the wheel, as measured by a scale, to hold the ship in a slightly steeper glide at a speed of 230 miles an hour!

From these studies we learned what is known as the stability characteristics, which we can decrease or increase at will. If a plane is too stable, it may be likened to an automobile that will run smoothly down a country lane, yet will not turn easily when the *(Continued on page 112)*

Plan City Airport Above River Thames

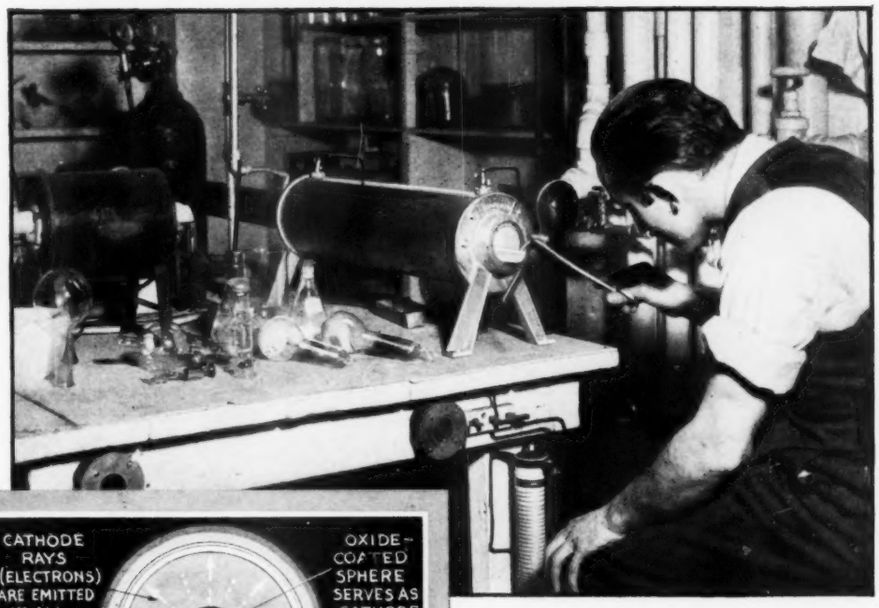


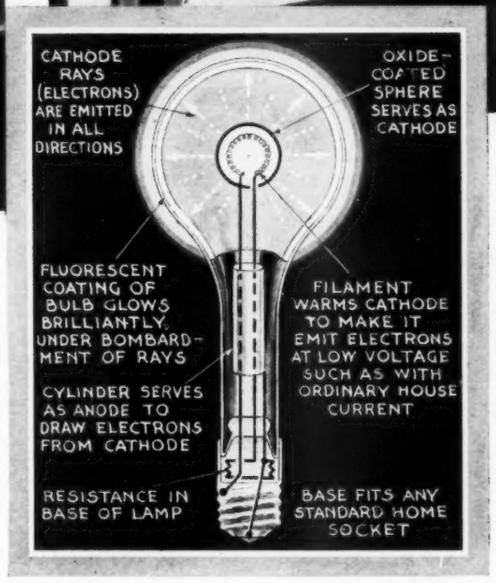
BUILDING a monster landing field over the River Thames is now being advocated before officials of the city of London, England, as a means of providing the city with an airport close to its business center. The bridgelike structure, according to one plan put forward, would be high enough to clear the tallest masts of ships and would include an upper deck for landing and a lower deck with hangar space for planes. The diagram above shows details of the project.

Firefly Light in Electric Bulb

Glowing Minerals in New Lamp Remain Constantly Cool

The new firefly lamp bulb. Note hand holding bulb to prove that, brilliantly lighted, it remains cool




CATHODE RAYS (ELECTRONS) ARE EMITTED IN ALL DIRECTIONS
OXIDE-COATED SPHERE SERVES AS CATHODE
FLUORESCENT COATING OF BULB GLOWS BRILLIANTLY, UNDER BOMBARDMENT OF RAYS
FILAMENT WARMS CATHODE TO MAKE IT EMIT ELECTRONS AT LOW VOLTAGE SUCH AS WITH ORDINARY HOUSE CURRENT
CYLINDER SERVES AS ANODE TO DRAW ELECTRONS FROM CATHODE
RESISTANCE IN BASE OF LAMP
BASE FITS ANY STANDARD HOME SOCKET

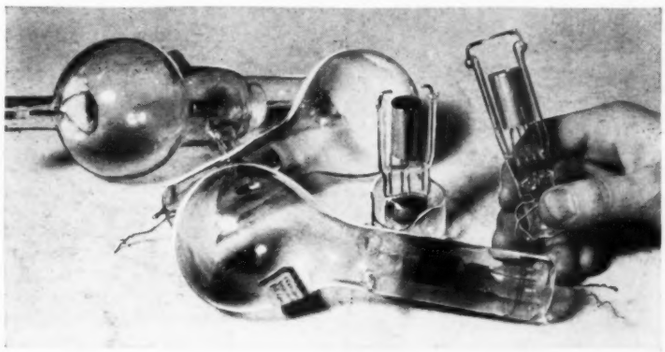
Above, preparing glowing chemicals for use in the cold-light bulbs. An electric furnace is used in this operation. At left, drawing shows construction and wiring of cold-light bulbs which are expected to be suitable for use in homes

IMAGINE the mysterious, cold, glow of the firefly multiplied a thousandfold and imprisoned in a tube of glass! By accomplishing this feat, through his invention of a fluorescent lamp bulb that glows brilliantly without heat, a young scientist of Brooklyn, N. Y., has paved the way for a new kind of electric lighting for the home. So far the new bulb has been produced only in experimental form, but designs for similar models suitable for household use have been worked out and await practical test.

Only in its shape, and in the fact that it may be installed in any home socket without change in the wiring, does the proposed new type of bulb resemble the incandescent lamp now used. Its light does not come from a white-hot filament of metal, but from a glowing coat of minerals on the inner surface of the bulb, which is cool to the touch. The mineral coating becomes luminous under the bombardment of streams of cathode rays, or electrons, which are emitted from a sphere at the bulb's center. When the bulb is used on low-voltage household current, a filament within the sphere warms it to assist in producing these invisible rays. When it is used for higher voltage, as for factory lighting and in advertising signs, this filament may be dispensed with. Light of any color, including white, may be obtained, according to the coating used.

What interests the scientific world about the new lamp is that it reproduces the cold light of the firefly and glowworm, long regarded with envy by laboratory workers who have tried in vain to duplicate it. Experts concede that the best of lamp bulbs now in use are wasteful and inefficient. They turn most of the current they consume into heat, which serves no useful purpose and may become a positive nuisance. Research workers have lately been developing lamps of other types, using luminous columns of gas, in an effort to obtain greater efficiency, but the idea of using fluorescent minerals that, under an electric bombardment, glow without any heat is an entirely new solution of the problem.

The secret of the new lamp, according to Gilbert T. Schmidling, its inventor, is its use of a new fluorescent mixture of exceptional brilliancy. Fluorescent materials in themselves are by no means new; in fact, about 11,000 compounds are known that have the curious property of glowing under bombardment by various kinds of invisible rays. Examples are the paint used on radium watch dials, the X-ray viewing screens used by surgeons, and the screens of cathode ray tubes used in television receivers. Testing thousands of these materials to study their adaptability to television screens, Schmidling came by chance upon a mixture that furnished a light brilliant enough for working and reading. Trials proved it could be used in an electric lamp, requiring only about one sixth as much current as an ordinary bulb to give the same amount of light.

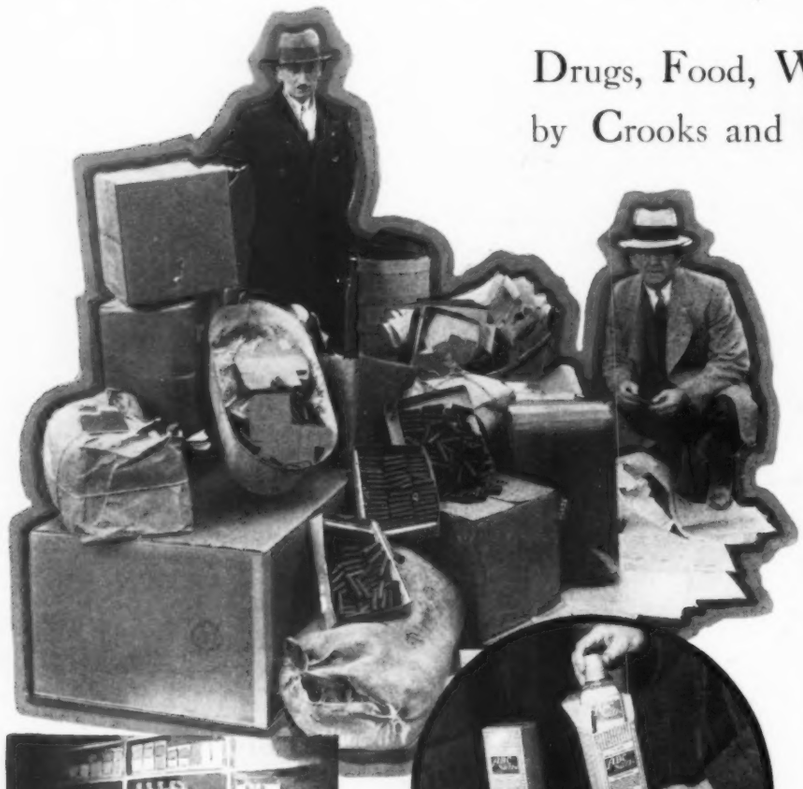


Close-up of several types of the glowing lamp bulb that constantly remains cool no matter how long it is used. Held in the hand is an electrode used in these lights when installed in homes

Vast Counterfeiting

Drugs, Food, Watches, and Tickets Made by Crooks and Sold Under False Labels

By Jesse F. Gelders



At the top are a number of counterfeit products and in the circle, a carton imitated by crooks for faked goods

CROOKS USE MACHINE TO FAKE IMPRINT

When the machine, shown at right, was confiscated by detectives, it broke up a plot to counterfeit a nationally known face soap. The machine was used to fake the manufacturer's imprint. Above, customer buying toilet articles has no way of telling the genuine from the counterfeit

ACROSS the counter of a Philadelphia drug store, a customer, who had bought a box of aspirin tablets, handed a one dollar bill. The druggist examined the dollar critically, then smiled an apology as he said:

"Can't be too careful. But this isn't counterfeit."

"No," snapped the customer, inspecting the little tin box he had purchased, "but this is!"

He was an investigator for the manufacturers, who had learned that their product was being faked. The containers bore their own name and trademark, and their name was stamped on every one of the little tablets. Yet the aspirin had not been made by them!

The investigator, by inconspicuous errors on the box, had identified his purchase as one of the counterfeits. He demanded to know where the druggist had obtained it.

Detectives were working with all possible haste to check the fraud before the spurious medicine was widely distributed. Through information from druggists, and by trailing salesmen of the fake product, they were able to round up members of the gang in Philadelphia and New York. They raided the gang's factory, and seized boxes of the fake medicine in powder form, a pill-making machine, and nearly 2,000,000 little tin containers bearing the counterfeited name and trademark.

This episode, with variations, has been repeated over and over throughout the United States, during the last few years. Scores of manufacturers, besides the makers of aspirin, have been given headaches by the crooks' brazen plots.

Counterfeiting has grown to be one of the nation's major criminal industries. The counterfeiting of real money is now far overshadowed by the counterfeiting of millions of dollars' worth of things of every imaginable kind. Not only the public purse, but health and sometimes even life, are jeopardized. Medicines, foods, watches, stocks and bonds, marble statues, stamps, razor blades, auto parts, and cigars are a few of the products that have been faked.

One gang put out $2,000,000 worth of counterfeit shares in one of the nation's largest corporations. New York police trailed the counterfeiters of a popular soft drink, and discovered a plant ready to produce $1,000,000 worth in one summer. For one championship prize fight, some $40,000 worth of counterfeit tickets were sold.

With tremendous values at stake, modern science and mechanical ingenuity are being called upon to check the depredations of the counterfeiters. Manufacturers are resorting to hidden markings, secret codes, and a new paper with invisible printing that shows up when dampened or held to a strong light. Museums

Racket FLOODS MARKET WITH FAKE GOODS

Prize-fight tickets printed on three layers of paper, the center one colored, in an effort to prevent the crooks from putting out imitation tickets. Note colored center, plainly visible when tickets are torn apart, as is being done by gate keeper in illustration at upper right, before permitting admission

A gang of soft-drink counterfeiters used this machine to print labels for their fake stuff. Detectives raided the plant and seized the printing press and mixing tanks. At left, the ultimate consumer for whom the bogus concoction was intended

and art collectors are protecting themselves from deception with ultra-violet light, X-rays, and many devices of chemistry and physics.

Unfortunately the role of science in this sensational struggle against crime, is a dual one. It helps the crooks as well as the forces trying to thwart them. One invention provides a distinguishing mark to prevent imitation. Another invention makes it easy to copy.

Recently the makers of a long-used medicine received complaints. Some of the medicine was proving ineffective, and moreover it was discoloring the users' mouths. Investigation disclosed that a fake product was being sold. The labels bore almost perfect copies of the long-familiar signature that had always been prominent on the genuine.

Not many years ago, the printed facsimile of a signature like that was considered a comparatively effective safeguard. But by photo-engraving it is no more trouble to reproduce a signature than any ordinary drawing.

For a time, a clever scheme foiled counterfeiters. Designs of labels and wrappings were printed in two or more colors. The colors had to be printed from individual plates; and once they were combined, the engraver's camera could not pick out one color at a time. It was a job like unscrambling eggs.

Then orthochromatic photography was developed. It unscrambles colors. The orthochromatic negative, when exposed through a color filter, makes it easy to reproduce the separate plates necessary for a multi-color illustration. It is a boon to legitimate engravers, but it is also just what the crooks needed.

Sometimes the photo-engraver may be in collusion with the criminal, but often he is himself the victim of deception.

A few months ago a stranger brought a New York photo-engraving firm three fragments of printing, one piece at a time, to be copied. When the third appeared, the engraver discovered they were all parts of a certain canned food label, which had been cut up almost like a jig-saw puzzle! A watch was kept for the man who had brought them, but he had become suspicious and never returned.

One of the most ingenious systems to nullify the opportunities which photo-engraving has given the crooks was developed after a spectacular fraud. The promoter of a championship prize fight discovered, when the preliminaries were about to start, that 1,000 spectators had got into the $40 seat section with counterfeited tickets. Even if the fakes could have been separated from the genuine, it was out of the question to put out 1,000 men, most of them probably innocent purchasers from the crooks. Hurried changes, seats in the aisles, and diplomacy were necessary to prevent that championship prize fight from being preceded by a battle royal among 1,000 seatless fans who had bought good tickets.

Afterwards the promoter asked a ticket-printing organization to devise a ticket more difficult to counterfeit.

The printers considered the tools at the disposal of the crooks, when they planned the new style. Precautions start at the mill which makes the cardboard on which the *(Continued on page 114)*

Experts Seek Way to Save

Plan Light-Tight Vaults and Archive Building to Preserve

By **ROBERT**

Papyrus, upon which the Egyptians kept records, crumbles to pieces in time and is laboriously put togethe as shown above. The mouth bandage is to keep the breath from blowing the bits away. At right, papyrus records preserved securely between glass plates

Above, a sample of papyrus upon which are Egyptian figures and hieroglyphics. It was made from the pith of a sedge that was native to Egypt

At right, a pictograph. It is an ancient record in the form of pictures and symbols carved on stone, a material used by many primitive races

IN THE heart of Washington, D. C., a gray limestone building is nearing completion. It forms the latest answer of science to the age-old problem of preserving records.

Known as the National Archives Building, it will house within its five stories and 459,000 square feet of floor space the precious documents and records of the Government. Automatic machines will maintain the 4,000,000 cubic feet of air within its walls at a constant level of humidity and temperature. Special alkaline sprays will remove atmospheric acids. Light-tight vaults will protect ancient papers from the deteriorating effect of daylight. Glazed tile and non-rusting metal will cover the floors and walls to eliminate dust. Built according to the recommendations of the U. S. Bureau of Standards, it embodies the latest ideas in document preservation.

It also represents the newest link in a long chain of effort that stretches back to the earliest days of civilization. Men of all ages have grappled with the problem of leaving behind records that would endure.

Cave men left crude drawings of the animals they saw scratched on the walls of their caverns. Mayans, in their amazing empire of 2,500 years ago, cut hieroglyphics in stone pillars and temple walls. Along the Nile, Egyptian Pharaohs set their slaves to erect the giant pyramids which formed their tombs and record vaults. According to the Greek historian, Herodotus, 100,000 men labored for nearly thirty years to build the Great Pyramid of Cheops, which, more than 5,000 years ago, was nearly half as tall as the Empire State Building, the highest structure in the world today.

In Babylonia and Assyria, men kept their records on tablets of clay. They imprinted the characters of cuneiform writing in soft material and then baked it to the hardness of stone.

A few months ago, archæologists working among the ruins of Erich, unearthed 1,000 of these tablets which have just been translated by Prof. Raymond P. Dougherty, of Goucher College, Baltimore, Md. He found they represent the office files of a Babylonian temple, showing bookkeeping notes and business transactions. Some of the clay tablets were found to be the equivalent of modern checks made out for payment to the bearer.

Probably the most mysterious of all the ancient records that archæologists have encountered lies on a lonely dot of land 2,000 miles out in the Pacific from the shore of South America. Easter Island, an enigma containing forty-five square miles, is ringed by more than 600 gigantic statues, each representing a human face from thirty to seventy feet high. Scientists estimate these products of artisans of some long-forgotten race are from 2,000 to 5,000 years old. Inscriptions which accompany them are in an unknown language that still baffles the experts. A possible clue has just been reported by a French scientist. He has found that the hieroglyphics bear a strong resemblance to ancient markings found in the interior of India.

As civilization advanced, new forms of record keeping appeared. The Greeks, although they, like the Egyptians, often wrote on thin sheets taken from the papyrus plant, set down their laws and public accounts on tablets of bronze. The Romans recorded important

World's Vanishing Records

Alkaline Sprays in National Nation's Precious Documents

E. MARTIN

laws on stone or bronze and less important records on papyrus, parchment made of animal skins, or on tablets of wood covered with wax. During the Middle Ages, monks laboriously copied in longhand whole libraries of books, using in place of paper, vellum, a fine parchment obtained from the skin of young animals. The invention of paper, more than 2,000 years ago, is credited to a Chinese high official, Tsai Lun.

Recently, experts of the U. S. Bureau of Standards tested a piece of paper manufactured in China fully a century before Columbus discovered America. Its fibers came from the inner bark of the mulberry tree, combining great strength and softness. More than 600 years old, it was as strong as modern paper produced by the latest methods.

With the invention of printing about 1450, a new era of record making began, leading to the modern high-speed press and the linotype. Wood-pulp paper and giant presses now make possible the cheap daily newspapers and widely distributed books which are a vital part of Twentieth Century civilization.

But as the speed with which written records can be set down has increased, the durability of these records has diminished. Newspapers yellow and crumble in a few years; magazines have a life that is measured in decades; books soon succumb to sunlight and acids in the air. Should some blight sweep over the world, killing all the civilized races, the printed records left behind would last but a few centuries.

In Denver, Colo., a project was recently announced for placing a thousand books and other papers, which would give a history of our civilization, in airtight copper boxes to be stored in sealed vaults in which they would last for thousands of years. A similar project has been started in Arkansas by "Coin" Harvey, the picturesque middle-westerner whose monetary plan figured in the first Bryan presidential campaign. Near his home, he has been constructing a pyramid in which he plans to place records of our times for future generations.

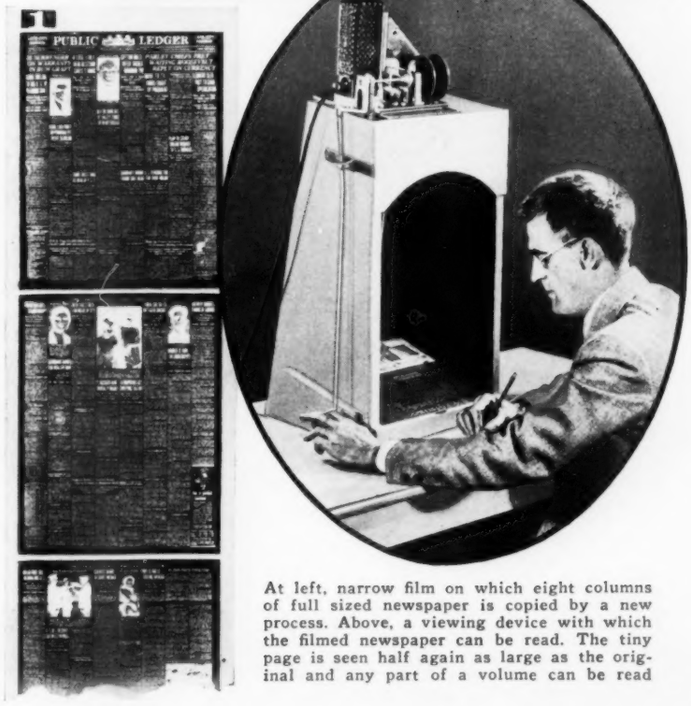
Thousands of years hence, what would archæologists find in exploring America? What records of our civilization would remain the longest?

That question was brought up last year at a meeting of scientists in London, England. In 5,000 years, they concluded, our steel and concrete skyscrapers would have crumbled into dust; our libraries would have disappeared; our machines would have disintegrated and become part of the soil. The best clue to our civilization which archæologists of a remote future would have, one expert maintained, would be the coins which are deposited in corner or foundation stones of public buildings.

Undoubtedly, the handiwork of our generation which will endure longest of all is the carving being done on the face of Stone Mountain in Georgia and in the Black Hills in South Dakota. It is estimated that the gigantic faces of Washington, Jefferson, Lincoln, and Theodore Roosevelt, being cut into the granite of the Black Hills under the direction of the American sculptor, Gutzon Borglum, will last for more than 500,000 years.

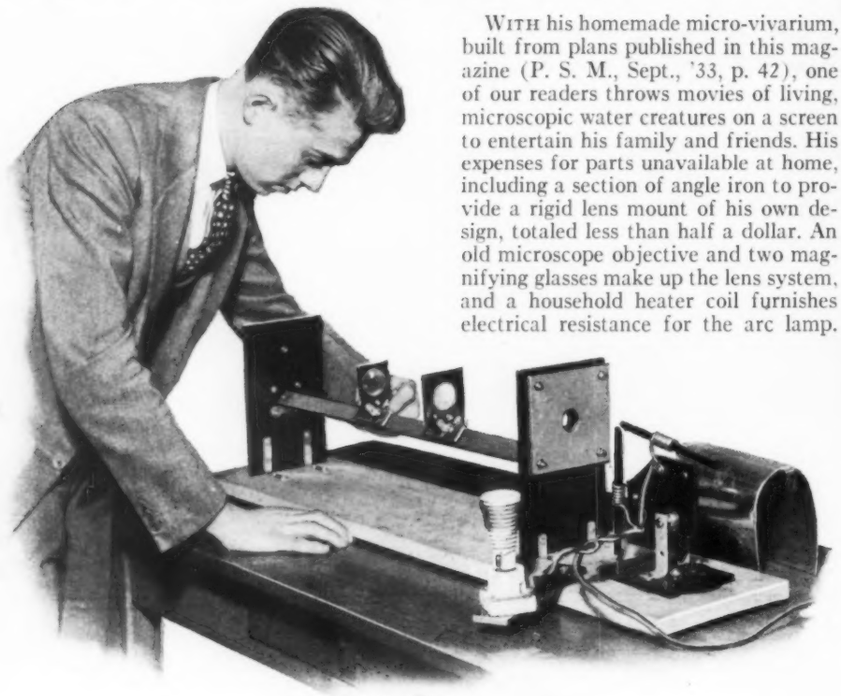
However, the problem which is most concerning scientists in connection with records is not their preservation for archæologists *(Continued on page 110)*

To keep newspapers from going to pieces, Japanese tissue is pasted over them. They are then hung up to dry. Above, special machine used to paste on tissue which formerly was applied by hand. Below, comparison of a modern paper, right, with one older but printed on much more durable paper



At left, narrow film on which eight columns of full sized newspaper is copied by a new process. Above, a viewing device with which the filmed newspaper can be read. The tiny page is seen half again as large as the original and any part of a volume can be read

BUILDS HIS OWN MICRO-MOVIE OUTFIT



WITH his homemade micro-vivarium, built from plans published in this magazine (P. S. M., Sept., '33, p. 42), one of our readers throws movies of living, microscopic water creatures on a screen to entertain his family and friends. His expenses for parts unavailable at home, including a section of angle iron to provide a rigid lens mount of his own design, totaled less than half a dollar. An old microscope objective and two magnifying glasses make up the lens system, and a household heater coil furnishes electrical resistance for the arc lamp.

This homemade micro-vivarium, built at a total cost of less than fifty cents, is used to throw living moving pictures of microscopic water creatures on a screen in builder's home

SUNSHINE FROM ORIENT MAY LIGHT OUR NIGHT

PIPING sunlight around the earth from the Orient to illuminate New England homes at night is a possibility predicted by Dr. Alexander Silverman, University of Pittsburgh chemist, if a cheap way can be found to manufacture fused quartz from beach sand. Rods of this glasslike substance, because of their curious powers of internal reflection, can conduct light around corners. The photograph above shows the largest block of fused quartz yet produced.

RADIATOR REFLECTOR DISTRIBUTES HEAT

MORE heat from your radiators, without increased fuel cost, is said to be provided by heat bouncers recently placed on the market. When these sheets of highly-polished aluminum are slipped into place, one behind each radiator, they catch heat that otherwise would be wasted in warming the wall, and reflect it into the room. The reflectors, as is seen in the picture below, are instantly installed or removed, requiring no special mounting.

Aluminum reflector throws heat into the room

Dr. Dexter, of Veterans' Bureau, Washington, D. C., is seen busy at his hobby. Right, examples of tiny models he makes

U. S. OFFICIAL HAS MANY HOBBIES

HOBBYIST extraordinary is Dr. Edward Grant Dexter, chief of one of the divisions of the Veterans' Bureau at Washington, D. C., whose home near the White House serves him as a workshop for his varied off-hour pastime. One of his creations is a homemade refracting telescope, fashioned from a discarded microscope and a cardboard mailing tube; another, a collection of forty walking sticks that he has carved by hand from rare wood. He holds a patent on his own original process of forming a silver-mounted cup and saucer from a coconut. Transforming an ordinary match, by whittling, into a fantastically intricate piece of woodwork provides him with one of his favorite diversions. A one-piece chain of eleven links, carved from a single match stick, took him only eleven minutes to complete. His collection includes match-stick models of pliers, dividers, tongs, and hinged rules. One of his masterpieces is an accurate model of a piston so small that its working parts are practically invisible. Held in one hand, the fragile piston may be slid back and forth within the wooden match that represents the cylinder. Remodeled dissecting knives are his tools.

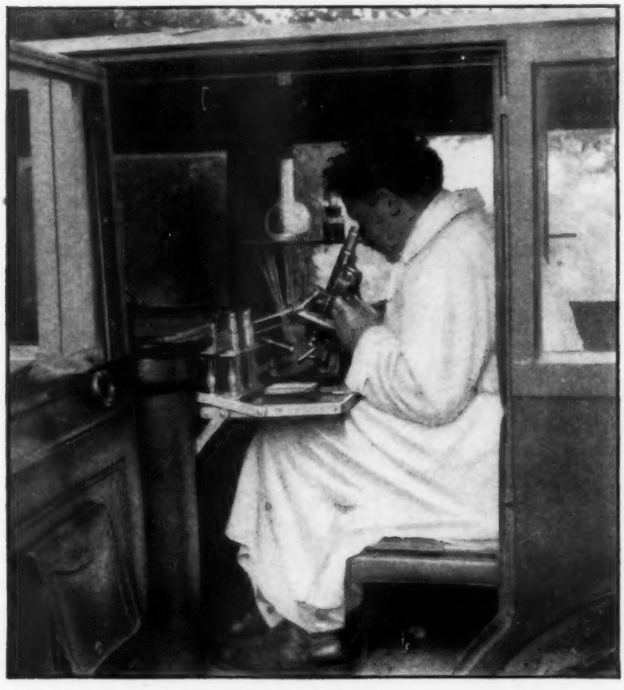
Below, finishing first scale model of a brontosaurus in action. It will be reproduced in concrete, 40 feet high

STATUES OF EXTINCT MONSTERS TO BE ERECTED IN CITY PARK

LIFE-SIZE reproductions of the brontosaurus, or thunder lizard, and fourteen other monsters of prehistoric ages, soon to be erected in a park at San Diego, Calif., will give visitors a startling glimpse of these extinct creatures. The first of the scale models, depicting the brontosaurus in action, has just been completed by Fred W. Temple, display engineer. Its full-size counterpart will be of reinforced concrete, and will measure forty feet in height and between seventy and 100 feet in length.

TRAVELING LABORATORY HELPS FIGHT SILKWORM PESTS

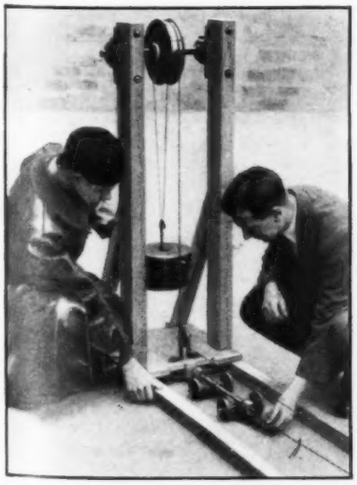
LITTLE competition troubles M. Paillot, French horticulturist and silkworm expert, in his specialized profession, for he is the owner of what is, perhaps, the only traveling silkworm laboratory in Europe. Each year he tours the silk-growing sections of France in his elaborately fitted automobile workshop, pausing wherever disease attacks the worms or plants to make tests and trace the source of the scourge. Built-in equipment, of an unusually compact design, enables the research expert to perform extensive chemical experiments and microscopic examinations. His services are said to have saved fortunes for the growers in the silk-producing districts.



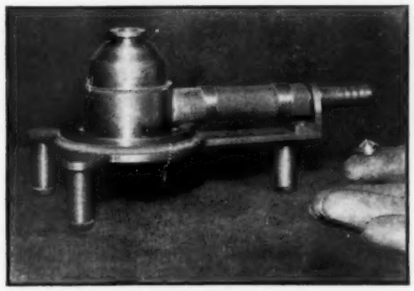
In this car, equipped for chemical and microscopic examinations, an expert visits the silk-growing sections of France and fights at first hand the destructive pests that attack silkworms and mulberry trees

START RESEARCH TO END SKIDDING

BRITISH government scientists have established a laboratory for research on skidding. In one of their tests, a miniature automobile chassis with one set of its wheels locked is catapulted along a model road, while a chart records the extent of its skid. A motor cycle sidecar, with a hinged wheel, is used in a corresponding test. The wheel is locked while the machine is moving, and an automatic recorder registers what happens. The experimenters hope to develop anti-skid road surfaces.



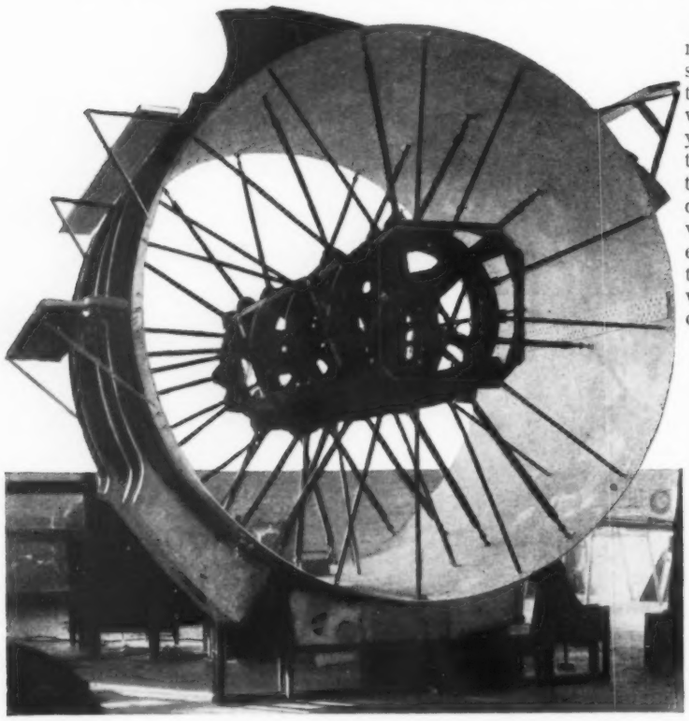
Above, chassis of model car and, right, motor cycle used in tests to end skidding



FASTEST TOP HITS 1,390 MILE SPEED

WHIRLING so rapidly that its outer walls travel at the amazing rate of 1,390 miles an hour, the fastest top in the world was exhibited in New York City the other day by its designer, Prof. J. W. Beans of the University of Virginia. Jets of hydrogen gas impinge upon its fluted under surface, supporting the pea-sized rotor of toughened steel and spinning it at terrific speed. Its use in the laboratory for tearing apart biological specimens, and for measuring the speed of light, is proposed. The picture above shows the top resting on a finger tip.

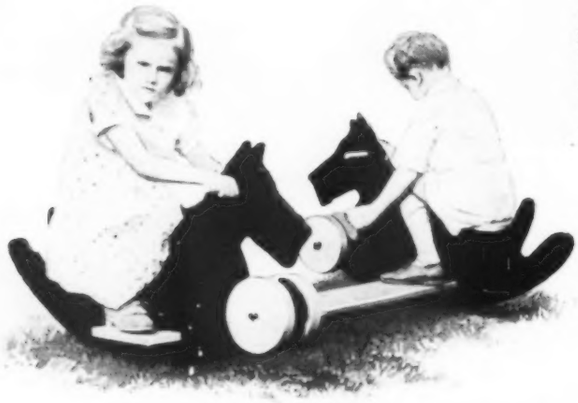
New Sub's Hull Plates Biggest Ever Used



Now undergoing its first sea trials, Uncle Sam's newest submarine, the 260-foot *Cachalot*, represents a new departure in submersible construction. Her hull plates, largest ever used for this purpose, measured about fourteen by twenty-four feet and were shipped in special cars to the Portsmouth, N. H., navy yard. Here they were formed in rings, like the one shown in the illustration, and the seams were joined by welding, making the *Cachalot* the first welded under-water craft. This method decreased the weight of the hull and provided more room for officers, crew, and equipment. Naval experts declare that the use of the oversize plates and welding will reduce the cost and speed up the construction of submarines.

Above, section of new submarine's hull during construction. Right, the sub in sea test

DOUBLE HOBBYHORSE RUNS IN CIRCLE



This double hobbyhorse moves in a circle when rocked

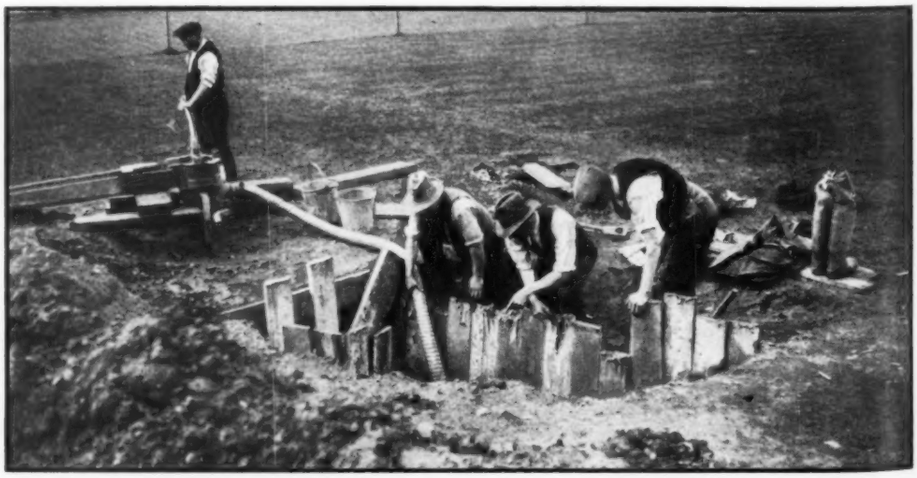
DESIGNED on a new mechanical principle, a merry-go-round hobbyhorse has just been introduced to provide fun and exercise for two children at once. Sitting facing each other astride their make-believe steeds, the young riders by rocking back and forth, can make the device describe a complete circle. Each horse advances a few inches as the wheels mounted upon it come in contact with the ground forcing it ahead.

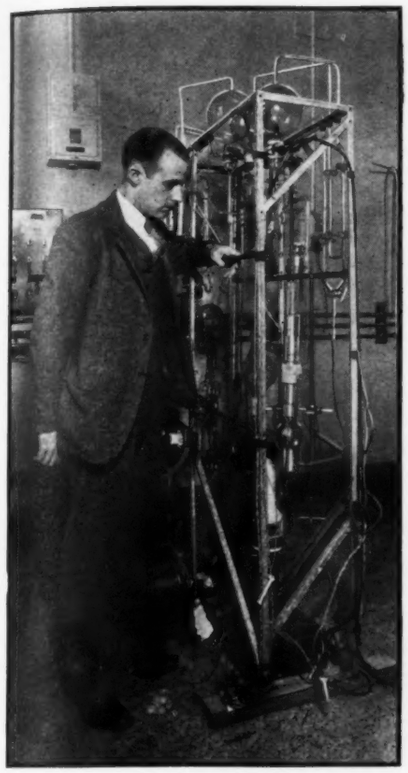
PLASTIC METAL FINISH

USEFUL as a metal finish and as a rust preventive, a plastic material suitable for coating such objects as metal hatchet handles and gun barrels has been introduced. The preparation is applied with a knife and when dry is sanded and rubbed to a glossy finish. It then feels like wood and looks like metal.

CITY ENDANGERED BY BURIED LAKE

WARWICK, England, may be in danger of sinking into the ground and disappearing. Since one of the municipal tennis courts suddenly dropped into a mysterious body of subterranean water the aldermen and citizens of Warwick are alarmed at the possible fate of their city. Investigation revealed a buried lake, formed by an underground river that runs the entire length of the town. The illustration at right shows laborers engaged in pumping out the water from beneath the lost tennis court as a first step in the necessary protective measures.



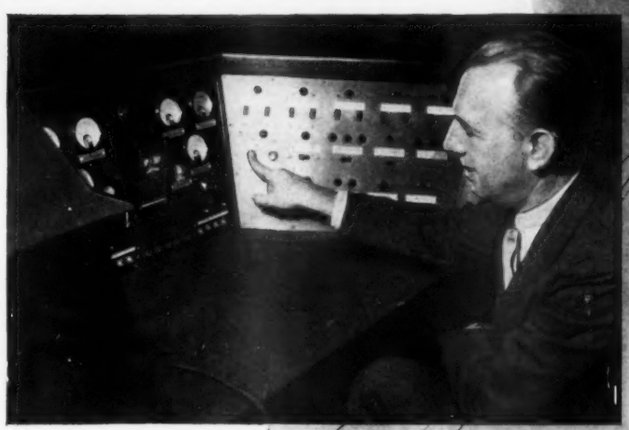


NEW VACUUM TUBE FOR ATOM SMASHING TESTS

FOLLOWING successful trials of their new 7,000,000-volt generator in a dirigible hangar at Round Hill, Mass. (P.S.M., Feb. '34, p. 19), scientists of the Massachusetts Institute of Technology have been casting about for a suitable tool to use in applying its terrific power to atom smashing. Now that tool appears to have been found in a new type of vacuum tube producing an unusual abundance of high-velocity protons, or positively-charged hydrogen nuclei, for bombarding atoms. The new atom gun, shown above, produces an electric arc between electrodes operating in hydrogen gas. The attempt to shoot the atom to pieces will be made in the belief that, in this way, the enormous amount of energy, thought to be stored in the atom, can be released. The answer to many of nature's baffling secrets might thus be discovered.

GIGANTIC RADIO STATION HAS 500,000-WATT POWER

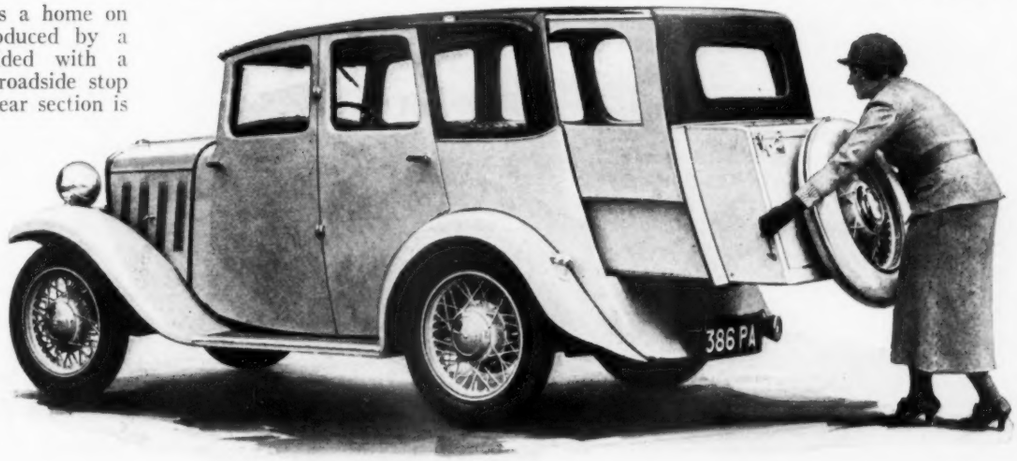
NEARING completion as this issue went to press, the world's most powerful radio transmitter will soon be heard by fans listening in on the 700-kilocycle channel between one and six A.M., Eastern Standard Time. Permission has been granted station WLW, Cincinnati, Ohio, to install the set and conduct experimental broadcasts with its full 500,000-watt power, which is ten times that of any commercial broadcasting station in the country. Its normal service range will be 2,500 miles, and under favorable conditions it is expected that listeners anywhere on the globe will be able to pick it up. A million gallons of water a day will cool the tubes of the mammoth transmitter. The largest audio transformer ever built, weighing 100,000 pounds, is a part of its equipment. The trials will test the theory of its builder, Powel Crosley, Jr., that such mighty power can be hurled into the ether without interfering with local stations, and that it will successfully override all static in carrying clear programs to listeners far outside local broadcasting areas.



This 831-foot vertical antenna will transmit broadcasts from the world's most powerful radio station. Inset shows the master control panel to be used during initial tests

CAR'S TELESCOPING BODY PULLS OUT, MAKING ROOM FOR BED

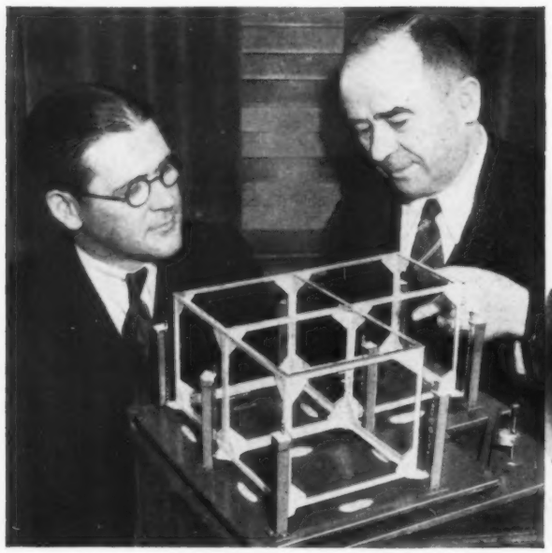
TO ENABLE it to serve as a home on wheels, a motor car, introduced by a British inventor, is provided with a telescoping body. When a roadside stop is made for the night, the rear section is drawn out as shown in the illustration. The seats of the car thereupon collapse automatically, making a comfortable bed. Working smoothly on rollers, the telescoping portion of the body is easily handled by one person. When it is closed, the car is of conventional appearance. Luggage space at the rear accommodates all the supplies required for an ordinary motor tour.



Checkerboard Stairs Test Floor

BECAUSE of numerous inquiries from architects and builders, experts of the U. S. Bureau of Standards recently set out to build a testing machine that would reveal how well different types of stone flooring would withstand wear. They produced a device in which a test block of stone is abraded by a grinding wheel that, for a given time, simulates the action of scuffing shoes. After that its loss in weight is determined. To check the machine's reliability, similar blocks of stone were installed checkerboard-fashion on the treads of a staircase that was in constant use. There they were exposed to natural wear for six weeks. After this practical trial, the experimenters remodeled their machine and made new tests.

Above, machine used in testing stone floors at the U. S. Bureau of Standards. At far right, checkerboard stairs put in use to gage accuracy of data secured by machine

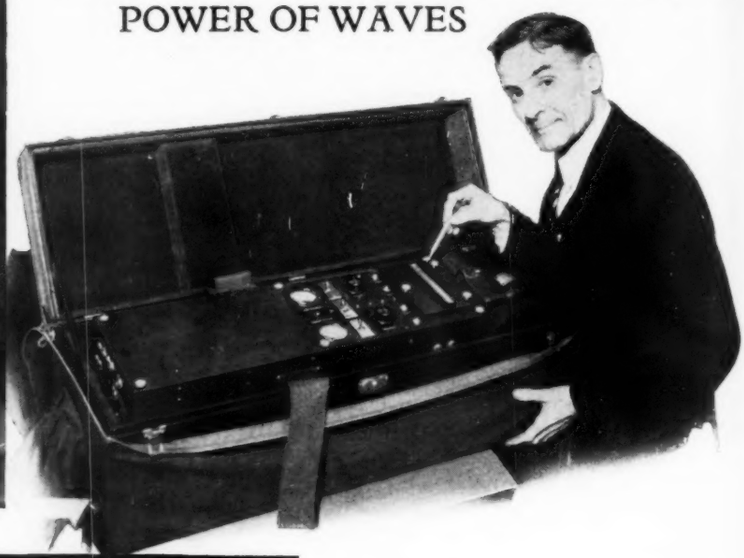


Model of quake-proof building swung on chains

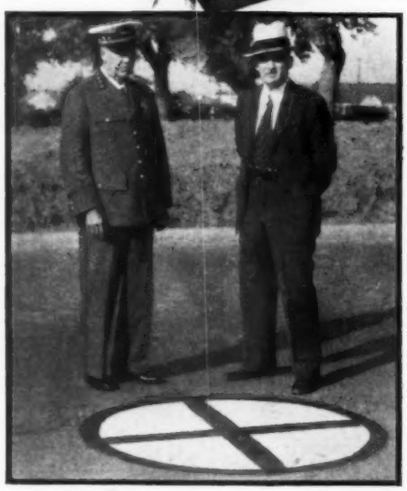
QUAKE-PROOF BUILDING TO SWING ON CHAINS

HANGING an entire building on chains hooked to supporting columns, to guard it from earthquakes, is the unconventional idea proposed by a Los Angeles, Calif., inventor. In his plan, the steel skeleton of a building would be provided with projecting members at its base, which would be devoid of the usual massive foundation. Instead, chains attached to the projecting parts would suspend the building bodily from a series of tall piers surrounding its outer walls. Such a structure, the inventor maintains, would not be subjected to destructive forces during an earthquake, since it would swing freely like a pendulum at every shock and would thus yield to the earth movement instead of resisting it. If desired, the whole supporting system of piers and chains could be placed underground.

SMALL ELECTRIC MACHINE GAGES POWER OF WAVES



HUGE rocks and other objects moved by ocean waves testify to their devastating power, but it remained for government engineers to find a more exact way of estimating their force. To learn the amount of buffeting to which piers are subjected, the engineers suspend a set of diaphragms in the path of the waves. The force of each wave is registered electrically in the oscillograph pictured above.

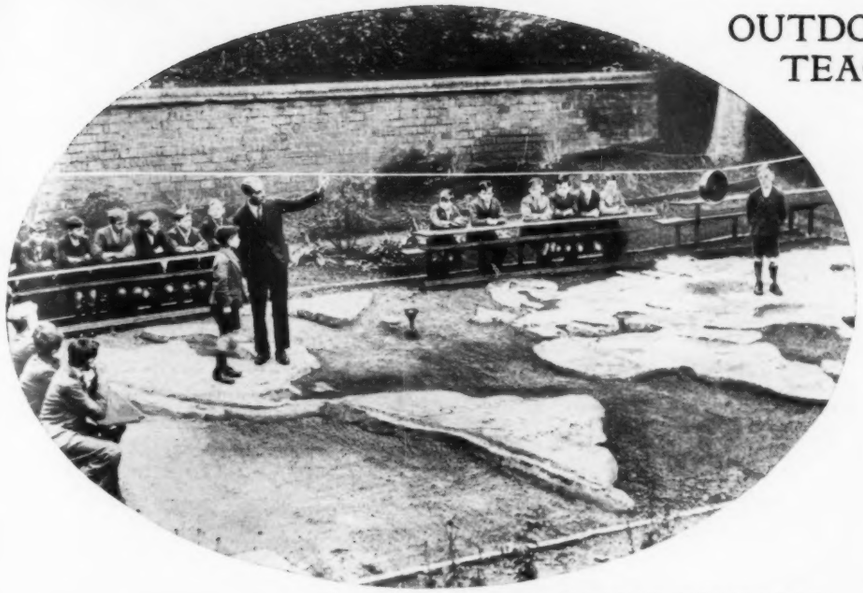


Black cross, painted inside circle, marks the scene of an auto accident and warns drivers

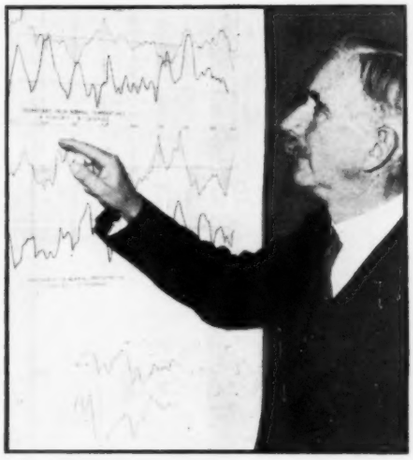
BLACK X MARKS SCENE OF FATAL CAR CRASH

SEEKING a way to reduce auto accidents, Chief of Police N. Matlock, of Phoenix, Ariz., has put an original plan into effect. Each time a fatal accident occurs, the exact spot is marked with a black "X" on a white background, encircled by a red ring. The marks warn motorists against reckless driving.

OUTDOOR MAP OF WORLD TEACHES GEOGRAPHY



PUPILS at a boys' school in Huntingdonshire, England, learn about the earth's appearance with the aid of a stone map laid out by the headmaster in a convenient vacant lot. Built to scale, the map measures twenty-four by thirty-six feet. A tin can, suspended overhead on strings, represents the sun and demonstrates its apparent daily journey around the earth. It also shows the varying angle of the sun's rays with the changing seasons. Thus members of the class acquire an idea of the position of the continents.



LONG-RANGE FORECAST GIVES 1948 WEATHER

FIRST tentative long-range predictions of the weather, including a 1939-1948 dry spell for central Nebraska, have just been made by Dr. Charles G. Abbot of the Smithsonian Institution, following his recent discovery that the weather repeats itself every twenty-three years. At right, he shows how recent Bismarck, N. D., weather bore out his predictions.

LIGHT THROWN ON ROAD TO SIGNAL CAR'S TURN

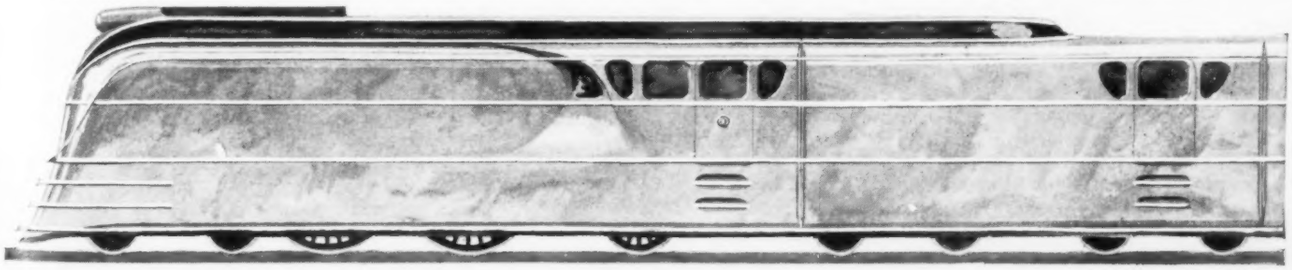
A FRENCH inventor has come to the aid of motorists traveling after dark by designing a turn signal based on the principle of a magic lantern. Thus it projects a warning, in illuminated letters, upon the pavement behind the vehicle. In this way the intention of the driver is unmistakably signaled to any following car and, it is said, no misunderstanding is possible. The illustration above shows the appearance of the new signal as it displays the French word "doublez," indicating a turn.

AIR PUMP RAISES PNEUMATIC TENT

YOU pump up, instead of set up, a pneumatic tent recently displayed in London, England. In place of the customary center pole and guy ropes, the shelter has a framework of air-tight cloth tubes that can be blown up with an ordinary automobile pump when the camping site is reached. When it is erected, the tent is six feet high and seven feet square. Deflated, it fits in a valise.

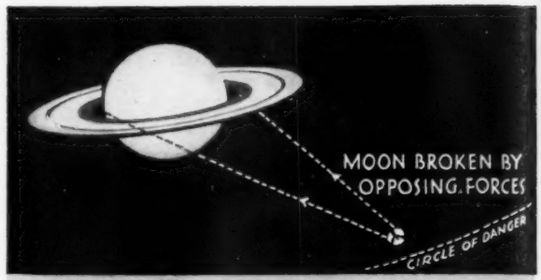
NEW STEAM LOCOMOTIVE IS FULLY STREAMLINED

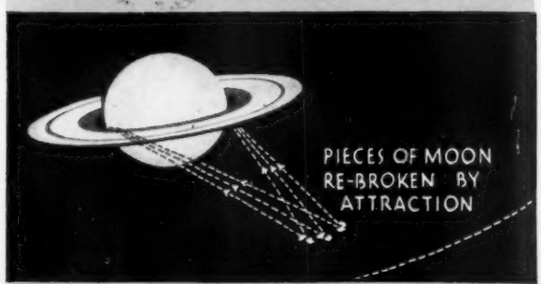
KEEPING pace with the development of streamlined gasoline and Diesel-powered rail vehicles, a leading American locomotive works announces that it is now ready to supply steam locomotives with the same speedy lines. The engines will be capable of two-mile-a-minute speed or more, if desired. One of the radical designs, shown below, completely encases the locomotive in metal sheeting to cut wind resistance. A compact smoke deflector serves the same purpose as the large side shields used on European engines, and the cowl atop the boiler encloses sandbox, dome, bell, and whistle.

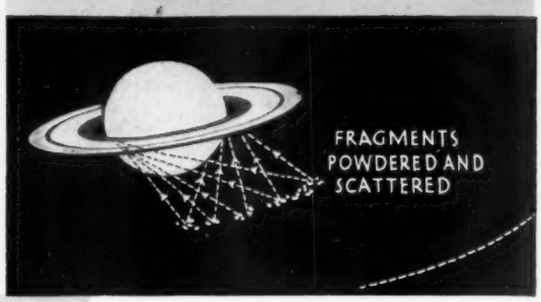


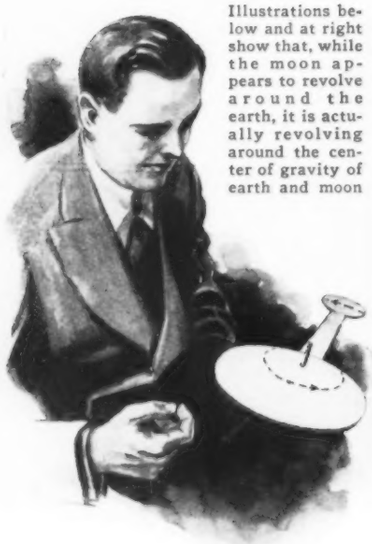
Simple Experiments Explain

Saturn's Rings AND THE Canals of Mars

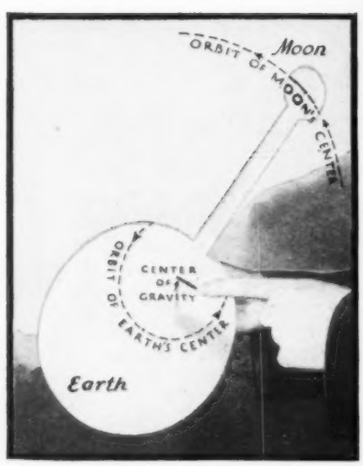








Illustrations below and at right show that, while the moon appears to revolve around the earth, it is actually revolving around the center of gravity of earth and moon



SHATTERED MOON BECAME A RING

Three views above give a clear idea of how Saturn's moon, having been drawn by gravity close to the planet, was destroyed by contending forces, crushed to powder, and set whirling in a ring of dust around Saturn

By
GAYLORD JOHNSON

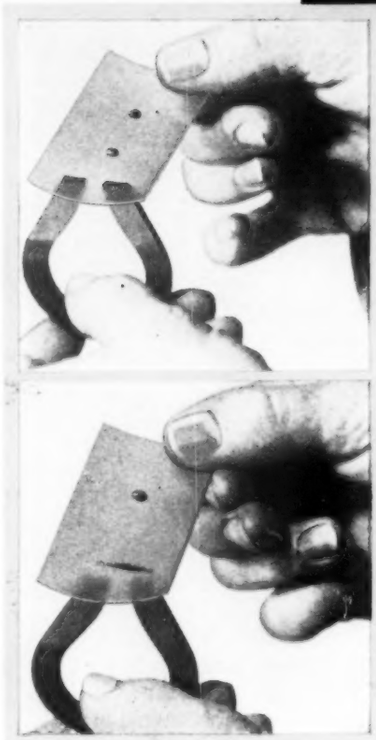
EVER since the great Dutch astronomer, Christian Huygens, discovered in 1656 that the planet Saturn is surrounded by flat rings, these unique objects have excited wonder and curiosity. No other planet has them; how were they caused?

After the telescope had revealed the nine moons of Saturn, some astronomers suggested that the rings were another satellite in process of formation. This, however, has proved to be the exact opposite of the truth. The rings are now known to be the smashed-up debris of a former satellite.

But what titanic power was equal to cracking up and pulverizing a moon that must have been even larger than our earth when the catastrophe occurred.

The answer given by modern science is simple: The attraction Saturn exerted upon its moons throughout millions of years gradually slowed down their revolutions and drew them nearer and nearer to the planet. Eventually a point was reached by the nearest moon at which its particles were being pulled in contrary directions by the masses of matter on opposite sides of the enormously larger body of Saturn.

When the moon could no longer resist these strains, it broke into several parts —and later, as the parts approached the planet still closer, they were split again and again. In this way, the contrary gravitational pulls of Saturn pulverized its nearest moon and converted it into a whirling ring of dust.



The two illustrations above show how the rings of Saturn may have been formed. In the upper one, two piles of iron filings are being brought close to a horseshoe magnet. The lower one shows how the filings are drawn into a line by the two poles of the magnet. Thus gravity wrecked Saturn's moon

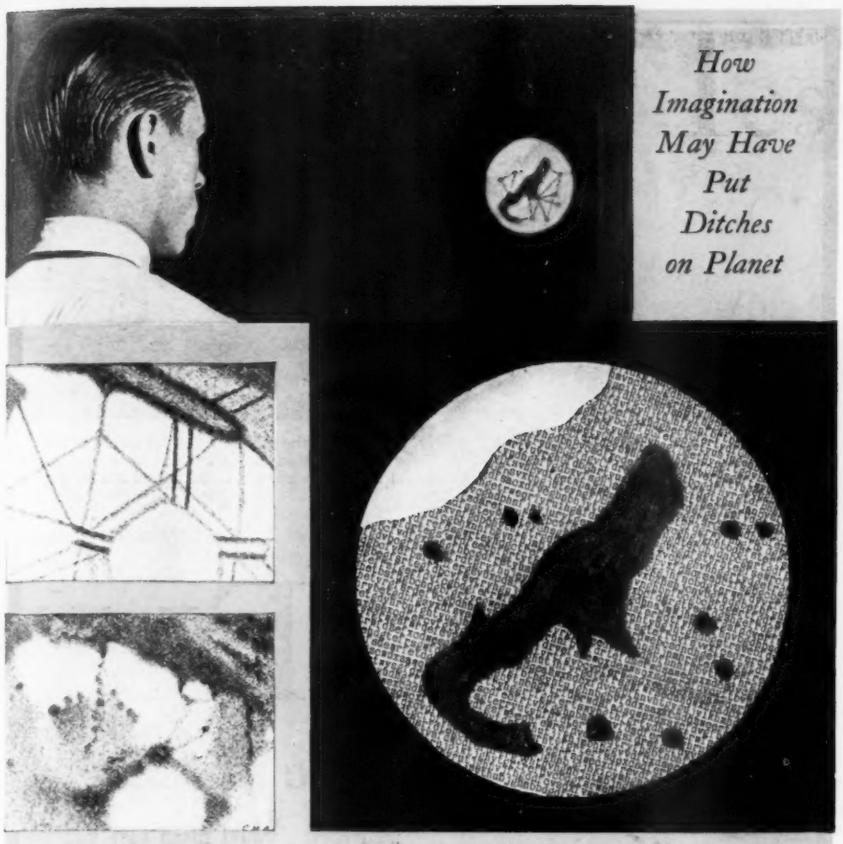
The point of near approach at which a moon begins to be in danger of being pulled apart by its parent planet was calculated mathematically by the scientist Roche, and is now known as Roche's limit.

This circle of danger is at about two and a half times the planet's diameter away from its surface. Accordingly, when our earth's moon has been drawn within this distance, that is about 20,000 miles from the earth, it will be broken up and form a ring around the earth. Of course the time at which this will occur is almost infinitely remote.

Astronomers say that the moon, Mimas, which is now nearest to Saturn, is already dangerously near to Roche's limit. Therefore in a few million of years, it may be torn to pieces and form another ring around Saturn.

The process by which a planet pulls its moons apart at Roche's limit can be illustrated by a simple experiment with

How Imagination May Have Put Ditches on Planet



The upper of the two figures, left above, was drawn by Schiaparelli, an astronomer who believed he had seen canals on Mars' surface. The other figure was drawn by an astronomer who thought the canals imaginary and not the work of intelligent beings

In circle is a typewritten model of Mars, consisting of a disk of paper covered with typed letters and having Martian seas and lakes indicated. At top, looking at this model with half-closed eyes and seeing "canals" caused by the letters running together

which these scientists base their conclusion that there are no canals.

Put a sheet of white paper in your typewriter and cover it with letters written haphazard, the lines being single-spaced. Then from the typewritten sheet, cut a circle about seven inches in diameter. Mount this on a black square and add a white polar cap. Also indicate roughly, with black ink and a water-color brush, a few of the principle Martian seas and lakes.

You now have a crude model of Mars, as viewed through a telescope, which will enable you to see some of the canals.

To do this, set up your typewritten map of Mars, half close your eyes, and back slowly away from it. When your vision of the individual letters becomes indistinct, stop and stare fixedly at the disk of your planet. In a few seconds you will see straight dark lines begin to shoot across the type matter from the round lakes to the points and projections of the big sea. These lines will come and go and vary in distinctness, but they will strongly suggest the canals drawn by Schiaparelli, Lowell, and other astronomers who thought they saw them.

According to the theory that is now gaining acceptance, the canals are formed by the astronomer's eye, which connects together into lines the details of the Martian surface which are too indistinct to see separately, just as your eye does with the individual typewritten letters. At this point some one may say, "But the canals have been photographed! Doesn't that prove their existence?" The answer is "No," for the lines appear just as distinctly *(Continued on page 108)*

a horseshoe magnet, a pinch of iron filings, and a bit of smooth, thin paper.

In this experiment the field of force around the poles of the magnet represents the gravitational attraction of the planet.

Place two tiny round piles of iron filings on a slip of paper, about half an inch apart. Each pile should be a mere pinhead in size.

Then rest the paper on the poles of the magnet and move the first dot of iron filings slowly toward the magnet.

In a moment the pile will be pulled apart toward both poles of the magnet and will form a thin line of filings. As you move the second dot of iron filings toward the magnet's field, it will be split in the same way.

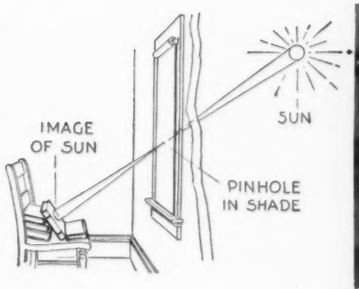
The planet Mars has provoked more discussion than any other of our neighbors in space, and this interest has centered largely upon its so-called canals.

These long, straight markings were discovered in 1877 by the Italian astronomer Schiaparelli. The American scientist Lowell gave many years to their study. Lowell declared the canals to be vast irrigation ditches, dug by Martian engineers to distribute the scanty water supply of their planet.

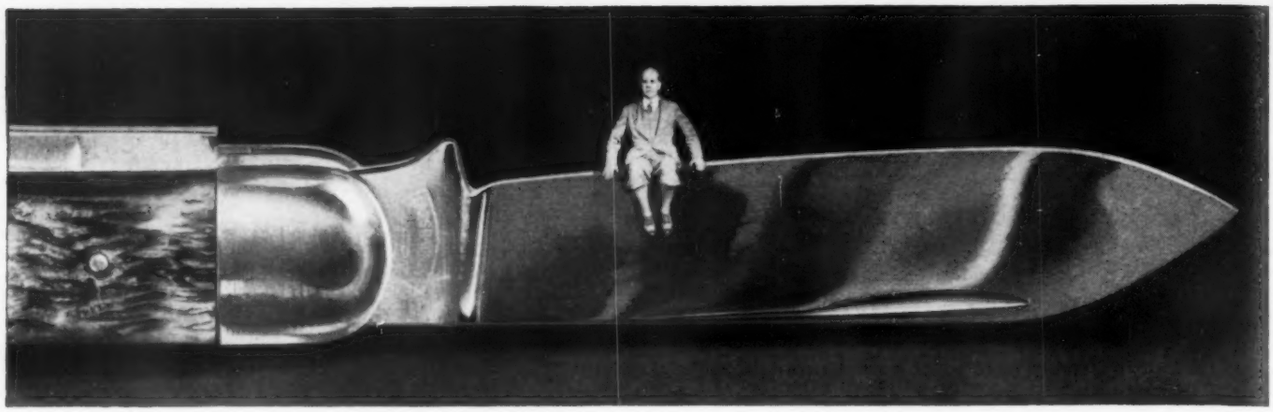
Astronomers of today are not so sure of this. Many of them now believe that the canals of Mars are not only not irrigation ditches but are merely optical illusions and do not actually exist.

An experiment easily performed will give you a part of the evidence upon

Pocket Rule Gives Sun's Size



HERE is a simple way to measure the sun's diameter with a pocket rule. The experiment should be performed about 9 A.M. or 3 P.M. Make a pinhole in the window shade at about your own height. Draw it down so the ray of sunlight coming through this tiny hole will throw an oval on the floor. Set up a sheet of white paper so it is exactly at right angles to the ray of light. Make two parallel marks on the paper, inside the bright circle. Move the chair toward the window until the disk exactly fits between the marks. Measure the distance between the marks with a rule reading to sixty fourths of an inch. Measure exactly the distance from the pinhole to the center of the disk. The distance of the sun from the earth is 93,000,000 miles. If the second distance is 10 feet 5.4 inches, and the first is 1.175 inches, you get this proportion, 125.4 inches: 1.175 :: 93,000,000 : X. The value of X comes out 871,000 miles, which is only slightly larger than the true diameter of the sun as determined by astronomers who use much more refined methods.

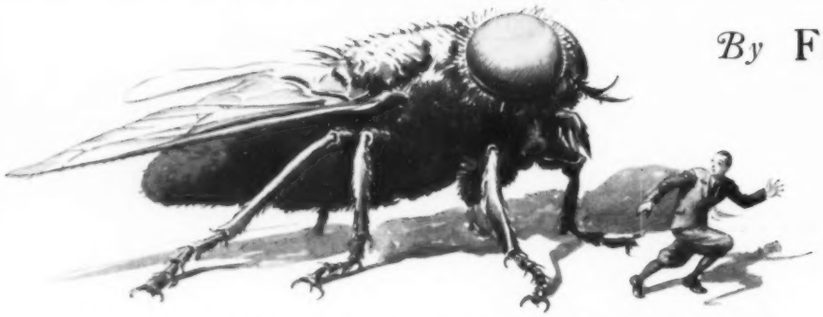


If a man were the size of a fly, he would be so light in proportion to his surface area that he could sit on the edge of a knife and not be cut

IF YOU WERE

Knee High to a FLY

By FREDERIC BARRETT



To a man only one eighth of an inch tall, an insect would be as dangerous as a tiger is to a normal-sized man. Its sting would undoubtedly cause the midget's instant death

MAN'S principal fear, oddly enough, is caused by the thing that makes most of his engineering feats possible—the attraction of gravitation. In other words all his life he is terribly afraid of falling.

Psychologists say this fear is the one thing a child does not have to learn. A very young baby will cry in terror if allowed to fall backward upon its pillows.

But an ant, or any other insect, never needs to dread the effects of gravitation. If you could be reduced to its size, you also would be freed from this terror. Because of the great reduction of your weight, and the much smaller decrease in the surface area of your body, the air resistance would buoy you up. If you were to fall from the top of the Empire State building, you would be so well supported by a cushion of air that you would reach the ground uninjured. Due to your slight weight, you could sit upon the edge of a razor-sharp knife blade without being cut.

Also your weight would enable you to use a spider's web for exercise in climbing. You could go up it like a rope ladder, or go hand over hand along its cables, for you would weigh no more than the spider. Due to the difference in specific gravity, you could stand upon a drop of quicksilver without sinking into it.

All of these things are caused by the operation of a law of matter that was first fully explained by the great Italian scientist, Galileo. Here is the gist of it: the weight varies as the cube of the length, and the surface varies as the square of the length.

Put in plain English, this means that if you divide a two-inch cube of marble by three saw cuts, so that you have eight one-inch cubes, each of the smaller cubes will have one fourth the surface area of the large one, but only one eighth of the volume, or weight.

If one of the one-inch cubes is similarly divided into one-half inch cubes, each of these will have one sixteenth of the surface area of the two-inch cube, but only one sixty fourth of its weight.

Continued division would eventually reduce the marble to a fine powder that would float in the air. (P. S. M., April, '31, p. 60.)

If you are a man five feet, six inches tall and weigh 150 pounds, reduction to a one-eighth-inch height would mean that you would weigh only a little over half a grain, or about 1/800 of an ounce avoirdupois.

This weight, compared to your surface area, would mean that, although you would have no fear of falling, you would become panic stricken at the thought of wind. You would be blown off your feet by even a moderately strong breeze.

You would be so light that, if your body were oiled, you could float on the surface of water without breaking through its film, as a fine needle can be made to do.

But the great decrease in your relative weight would give your muscular strength far greater powers. You could jump several times your own height. You could lift objects much larger, comparatively, than you can in your normal size. This explains the apparently phenomenal strength of insects and much of their leaping powers.

As a one-eighth-inch man, the insect which you carelessly step on now would

Wind would be a real terror to an insect-sized man as the slightest breeze might blow him away as it does the leaves

become a real terror to you. A bee or mosquito would be as dangerous as a tiger in the jungle. A sting would cause death.

One of the most interesting changes in the world you would live in as an ant-high man would have to do with water. If you stood at the edge of a tiny pool, the water would curve downhill away from you, due to the rise of the liquid, through surface tension, on the sides of the container.

If you went in for a swim, you would have to take care not to be pulled violently toward the sides of the swimming pool, as a floating match-stick is in a cup of water. If another swimmer were in the pool with you, approaching him too closely would result in the two of you being drawn suddenly together.

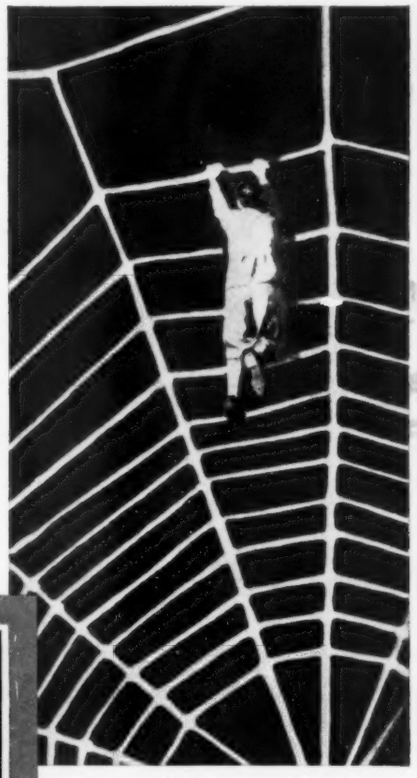
If you entered the pool with a lump of camphor held behind your back, you would be propelled through the water like a motor boat, due to the lessening of the surface tension of the water behind you. To see this effect, attach a little piece of camphor to the rear of a half-inch-long paper boat.

A drop of water spilled upon the floor would curve up in front of you knee-high. If you stepped into it, the surface tension would draw the water up your body above your waist, and when you tried to walk out you would not find it easy. The surface-film of water would hold you as if it were sticky molasses.

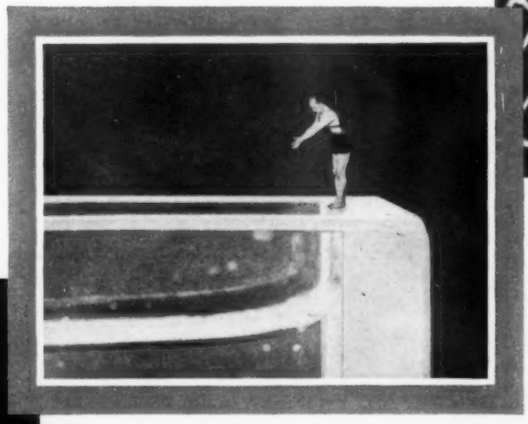
On the whole, life in the Lilliputian world would have fully as many disadvantages as advantages, and you might be more than willing to resume your normal size. This in spite of the fact that ice on the sidewalk is now a real danger to you, as any fall may be serious.

FALLING Would Have No Terror for a Man the Size of an Insect—He Could Jump Several Times His Own Height and Sit on the Edge of a Sharp Knife with No Danger of Being Cut

Judging from the insects, a fly-high man would be able to carry a much heavier object, proportionately, than he can now



Since the little man would weigh no more than a spider, he could climb a spider web like a ladder



One advantage of the Lilliputian man would be his ability to leap several times his own height, since the air would help to support him

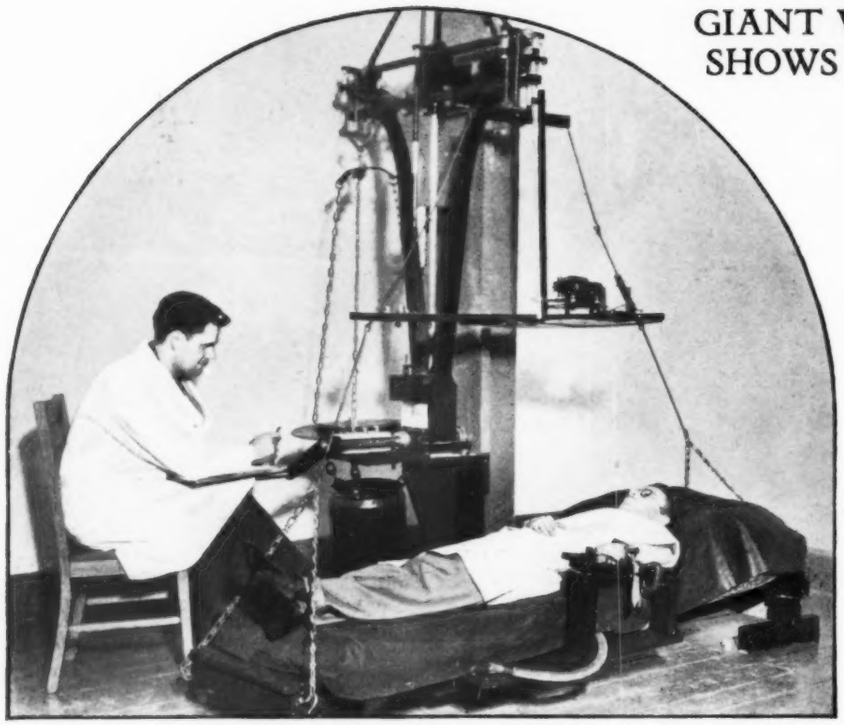
Water in a tank would, to an insect man, curve down away from him as surface tension would raise the water slightly around the edges of the tank

Due to his great surface area and light weight, the midget could float on the surface of water without breaking its film exactly as a steel needle will float on top of a cup of water

If a tiny man stepped into a drop of water, it would instantly rise around him, probably as high as his waist

GIANT WEIGHING MACHINE SHOWS CHANGES IN MAN

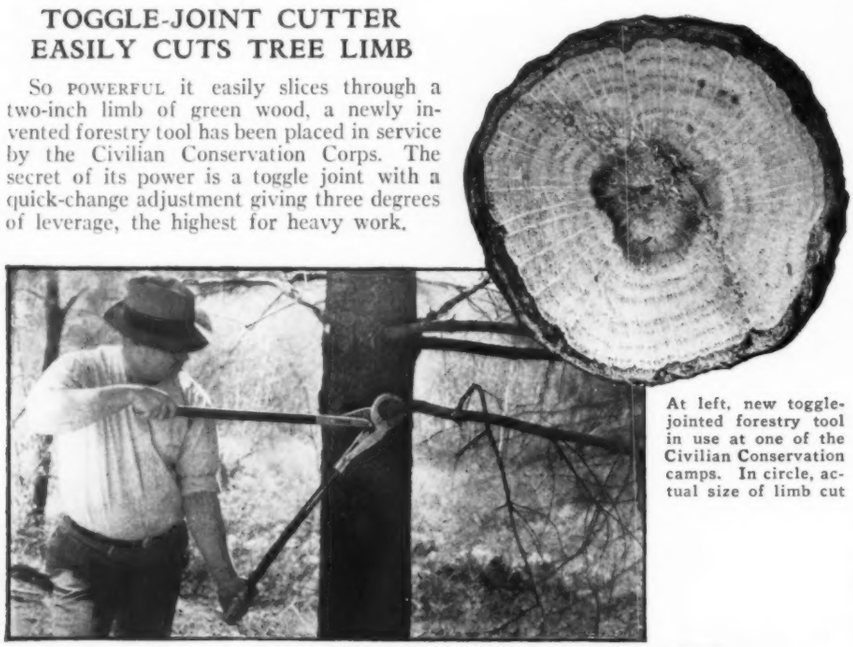
USING a giant weighing machine to support a couch on which a subject is lying, psychologists of Northwestern University are studying the change in an individual's weight from minute to minute, as well as his varying pulse rate and other factors that affect his working efficiency. In one series of tests, the scientists obtained definite figures to refute the superstition that the position of sun, moon, or planets in the sky has the slightest influence upon human activity. The changes, they say, are due to man's environment.



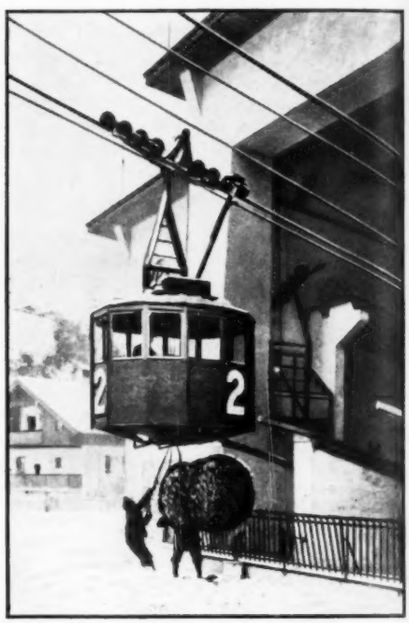
Prof. G. L. Freeman, psychologist at Northwestern University, uses this big weighing machine to observe the minute-to-minute changes that occur in weight of subject lying on the couch

TOGGLE-JOINT CUTTER EASILY CUTS TREE LIMB

SO POWERFUL it easily slices through a two-inch limb of green wood, a newly invented forestry tool has been placed in service by the Civilian Conservation Corps. The secret of its power is a toggle joint with a quick-change adjustment giving three degrees of leverage, the highest for heavy work.



At left, new toggle-jointed forestry tool in use at one of the Civilian Conservation camps. In circle, actual size of limb cut

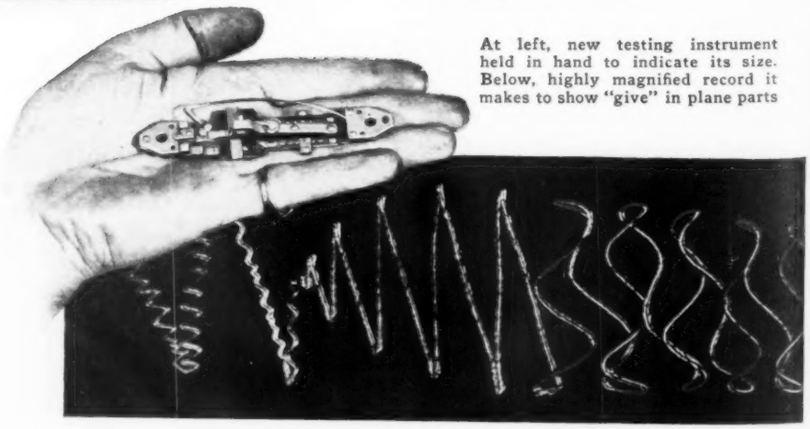


FOOD FOR WILD ANIMALS SENT BY CABLE RAILWAY

A CABLE railway was the unusual means of transport pressed into service the other day to rush food to starving wild game in the Latten Mountains of southern Germany. Bales of hay were fastened beneath the aerial cars, as shown above, and dispatched to the mountain tops to serve as forage for the woodland animals, which were facing famine as the result of the unusually severe winter. Government officials superintended the loading of the fodder and its distribution in haunts frequented by the animals.

USE ONE-OUNCE DEVICE IN TESTING AIRPLANES

WEIGHING less than an ounce, a tiny testing instrument has been developed to measure pulling, pushing, and twisting strains in aircraft parts. Used during their manufacture to insure safe design, it records just how much each one will yield under varying loads by writing its own autograph on a moving steel strip. The strips are read by means of a microscope or photomicrograph. Other applications for the new instrument are foreseen in testing the members of skyscrapers and bridges, the framework and plating of ocean liners, and all types of machinery.



At left, new testing instrument held in hand to indicate its size. Below, highly magnified record it makes to show "give" in plane parts

At right, towerlike hotel that has no two rooms on the same level. Above, view of winding ramp that runs from top to bottom of the circular hotel. Off this are the rooms

TOWERLIKE HOTEL HAS NO TWO ROOMS ON SAME LEVEL

TOWERING above the surrounding country like a lighthouse, one of the strangest of hotels has just been opened at Sestrieres, in the Italian Alps. Not only does its round tower contain no stairs, but no two rooms are on the same level. At the center of the structure, an open well extends from top to bottom, and accommodations for guests are provided in rooms surrounding this well. To give access to the rooms, a continuous spiral ramp encircles the central well. This gently sloping walk makes fifteen revolutions in the course of its ascent, and the entrances to fifteen rooms open off from it during each complete turn. Its winding form gives it a striking aspect when viewed from one of the upper levels, as shown in the illustration. For the use of guests who are less energetically disposed, two elevators are also provided. The flat roof of the base of the structure two stories above the snow-covered landscape, serves as a promenade and provides room for many outdoor games.

MACHINE PUTS NATION'S GREAT SEAL ON PAPERS

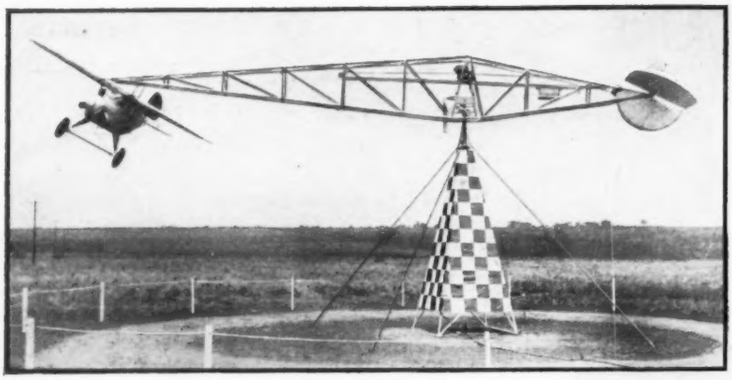
PRESIDENTIAL proclamations and other state documents of high importance are made effective by affixing the Great Seal of the United States, which in reality, constitutes the nation's signature. Lately the half-ton device that carries out this little-known and interesting formality has seen increasing service. To affix the seal, a paper wafer is first pasted on the document, beside the signatures of the President and the Secretary of State. The paper is then slipped between two matched dies on the machine. Twirling a weighted handle forces the three-inch dies together, impressing the design of the seal.

KILL TREE PESTS FROM HIGH PLATFORM

WAGING war on insect pests, from an overhead point of vantage, is made possible for orchard owners by an insecticide truck of English invention. Drawn by a tractor, it carries two tanks of the liquid poison and supports an elevated platform where the sprayers work. Two men in the crow's nest of the apparatus apply the insecticide to the tops and the sides of the fruit trees with the aid of their spray nozzles, thus reaching parts of the foliage inaccessible from the ground.

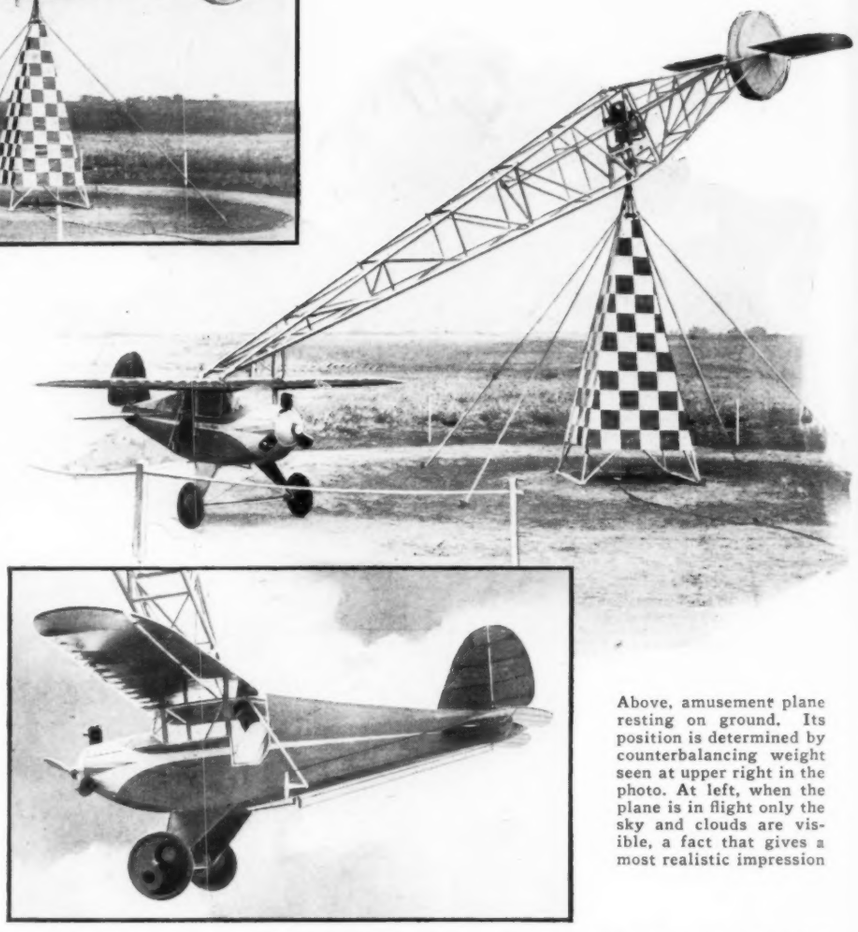
From the vantage point of the high platform, which rests on a tractor-drawn truck, workmen are able to spray the tops of trees with insecticide in their effort to kill the pests

PLANE, HITCHED TO POLE, FLIES LIKE REAL THING



Counterbalancing weights enable this plane to fly, with a passenger, at twenty miles an hour around the post to which it is fastened

ALL the sensations of flying are produced by an amusement device perfected by an inventor of Schulenberg, Tex. The thrill-seeker seats himself in a miniature plane, the weight of which is then reduced nearly to zero by an electrically operated counterbalance. When the plane's electric motor is started, it taxies around a supporting pole and takes off realistically, diving or zooming at any height from one to twenty-five feet from the ground in response to a touch of the pilot's controls. When the power is throttled down or cut off, the plane glides to a graceful landing. An anchor is provided to hold the plane on the ground when empty.



Above, amusement plane resting on ground. Its position is determined by counterbalancing weight seen at upper right in the photo. At left, when the plane is in flight only the sky and clouds are visible, a fact that gives a most realistic impression

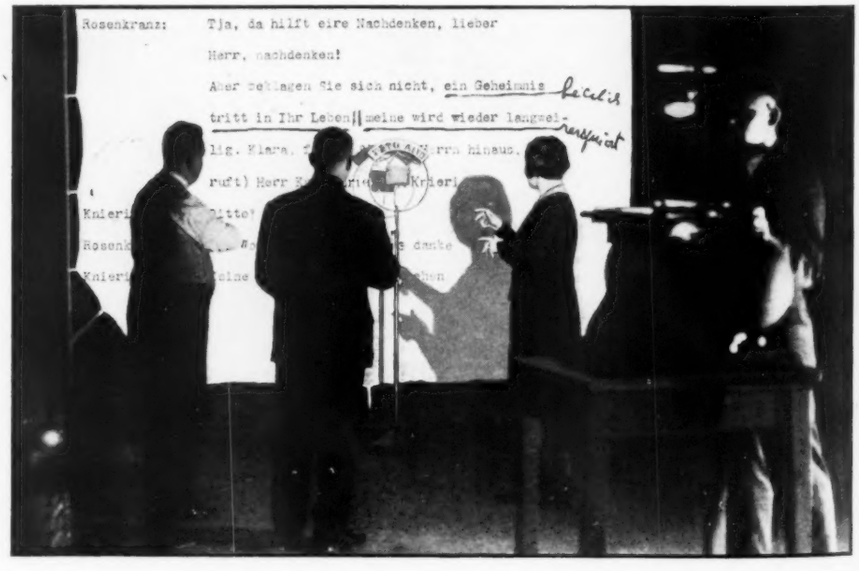
Light filter of two liquids and glass particles gives any colored light desired

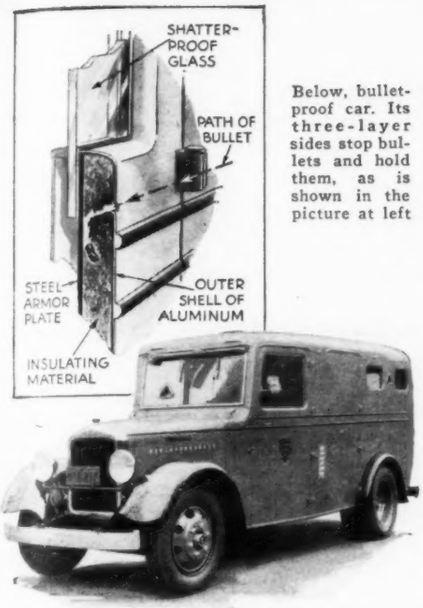
LIQUID FILTERS YIELD LIGHT OF PURE COLOR

MIXING benzol and carbon bisulphide, and adding tiny particles of broken glass, Smithsonian Institution scientists have obtained light of pure colors. Its effect on plant growth is being studied. When the vessel holding the mixture is placed before a lamp, light of any color is transmitted by varying the temperature or the proportions of the liquids until they, and the glass particles, have the same refractive power for the desired color. Light of unwanted colors is scattered by refraction. This method is declared superior to the use of colored screens.

WORDS ON SCREEN HELP RADIO ACTORS

RADIO dramas are now being made more lifelike by projecting the players' lines upon a large screen in the broadcasting studio during the performance. Reading their parts from the enlarged script, the actors are able to play them more realistically than they could if individual manuscripts were used. In addition to this, the stage manager can give directions and suggestions to the performers, while the broadcast is going on, by writing his ideas in marginal notations. The photograph shows a try-out of the innovation at Frankfort-on-the-Main, Germany.


Rosenkranz: Tja, da hilft eins Nachdenken, lieber
Herr, nachdenken!
Aber zerbrechen Sie sich nicht, ein Geheimnis
tritt in Ihr Leben, meine wird wieder langwei-
lig.



Below, bullet-proof car. Its three-layer sides stop bullets and hold them, as is shown in the picture at left

ARMORED CAR STOPS AND HOLDS BULLETS

PROVIDED with bullet-catching walls, an armored car of new type protects bystanders from the hazard of ricocheting bullets in the event that it is fired upon. Its three-layer wall has an exterior shell of aluminum, a sandwichlike filling of insulating material, and an inner barrier of steel-armor plate that is impervious to projectiles. When a bullet penetrates the outer shell, it rebounds from the armor and is trapped in the insulating material.

USE ALUMINUM ON TELESCOPE MIRRORS

SILVERING the mirrors of astronomical telescopes may become a thing of the past as the result of successful experiments in giving these mirrors a coat of aluminum instead of silver. The aluminum face, virtually non-tarnishing, has the additional advantage of reflecting ultra-violet rays with great facility. It is applied by heating aluminum to vapor in a vacuum, the condensing vapor forming the metallic coating. In the accompanying photograph the new process is shown being used to coat the thirty-six-inch mirror of the Lick Observatory in California, the largest mirror thus treated to date. The mirror itself is seen in the foreground, mounted on a track for convenient handling, while behind it is the vacuum chamber with the aid of which the aluminum finish is deposited on the glass.

Applying aluminum coat to Lick Observatory's mirror. The apparatus used in the process is in the background

NEW ANTI-AIRCRAFT TRUCK

TO GUARD ground troops against close-range strafing by enemy attack planes, a speedy new U. S. Army anti-aircraft truck, tried out successfully at Fort Bliss, Texas, may be rushed to any part of the defense line at a moment's notice. Its three machine guns are mounted so that they can be swung in unison to any angle, filling the air with a barrage in which no low-flying aircraft could survive. Oversize balloon tires enable the truck to make fast time over rough country, while its short wheelbase permits it to turn and maneuver with unusual ease.

New Army truck carrying movable anti-aircraft guns

TINIEST TRACTOR TURNS IN SIX-FOOT SPACE

CAPABLE of twisting with ease around trees and turning in cramped quarters, a baby tractor, perfected by an Italian agricultural scientist, is called the smallest in the world. Its pivoted tractor tread enables the machine to turn completely around within a yard and a half of space, as illustrated above. A quart of gasoline is declared sufficient to drive the one-cylinder, five horsepower motor during two hours' work.

Microscope Adventures

MORTON C. WALLING *Tells How You Can Have Many Exciting Hours Watching the Tiny Creatures in Your Aquarium and How You Can Take Good Photos of Them*

HERE is a mystery you may be able to solve: While on a trip through a world of microscopic wonders, the fish bowl, a group of amateur microscopists came upon Pete. Pete is, or was, a baby tropical fish, a red moon about three-eighths of an inch long. He had a name because he was the solitary survivor of a school of young moons. In fact, it was Pete who attracted attention to the fish bowl in the first place. An argument arose about his ability to consume pieces of food larger than himself.

"I wonder if he has teeth," one of the trio remarked.

"Surely not, in a fish that small," another declared.

"I'll bet he has," said a third.

"It'll be easy enough to find out," the first said. "Just put Pete under a microscope."

This was not as easy as it sounded. Pete, being of considerable size as microscope specimens go, and very lively besides, obviously would not pose on a glass slide while his mouth was examined, unless special precautions were taken.

These precautions, as finally worked out by the three eager microscopists, consisted of cutting a ring out of a hard composition to form a cell on the slide. This ring was made by sawing a one-sixteenth-inch section from a radio-coil tube one-half of an inch in diameter. The ring was cemented to the glass slide with shellac. When this had dried, Pete was put into the depression formed by the ring, three or four drops of water added, and a cover glass dropped into place. The glass pressed gently on Pete's back, just enough to keep him from wandering about the small enclosure.

It required less than a minute to prove to the three observers that Pete had sharp, tiny teeth in an even row along the jaw. This indicated that the tiny fish, by working at a piece of food almost as big as himself, could nibble off enough for a substantial meal.

"Let's see what else we can find out about him," one of the explorers suggested.

So Pete's privacy was invaded again. A small area on his side provided enough entertainment for a half hour. At low magnification, the scales in orderly array were rendered distinctly visible. At a higher power, the tiny ridges of the individual scales could be seen.

But the most beautiful picture was provided by the pigmented cells. Pete, to the naked eye, looked reddish with black markings. Under the microscope, his true beauty was brought out. Four colors were found. That is, there were four kinds of pigmented cells or chromatophores, as the zoologist calls them. Most prominent were the black ones that looked like a splatter of India ink. Then there were fairly large red pigmented cells, mixed with smaller orange and yellow ones. Such brilliant color spots are found in many fishes which, to the unaided eye, appear drab. Chromatophores of different colors combine to form other hues. Thus yellow mixed with black produces a brown that greatly improves the fish's color scheme.

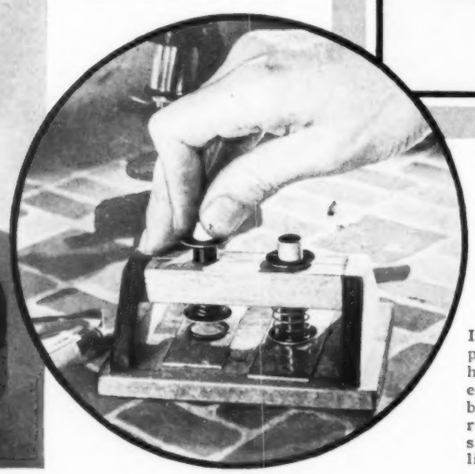
"I can't get all these color patches in focus at once," one of the observers complained. He was using 100 diameters magnification.

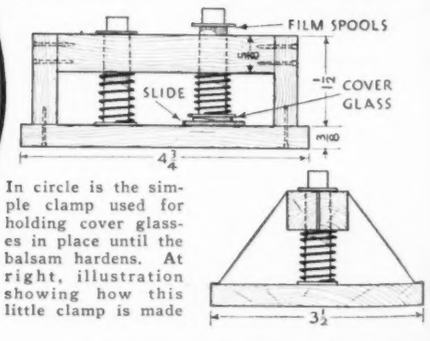
"That must be because some of the cells are deeper than the others," another said.

"Yes," the third added. "The black ones seem to be nearer the outside."

Pete's heart provided a fascinating exhibition. Through the lens it could be seen, beating with apparent vigor, although Pete himself was not moving. The red blood could be seen rushing out of the throbbing sack as it contracted, and rushing in when it expanded.

At right, the head of a water flea as seen under a microscope. It is raised for fish food. Lower left, baby fish inside a hard composition ring over which is a cover glass. In this way the fish is held and studied

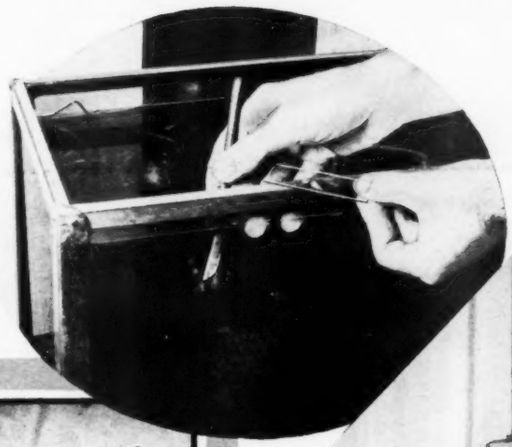




In circle is the simple clamp used for holding cover glasses in place until the balsam hardens. At right, illustration showing how this little clamp is made

in a Fish Bowl

The manner of collecting plants and animals from an aquarium and placing them on a glass slide is shown at the right. Below, a few of the tiny creatures that will be found in a fish bowl. They are attached to microscopic plants by means of the long threads which are muscular in nature



Pigmented scales, found on tropical fish, when highly magnified appear as above

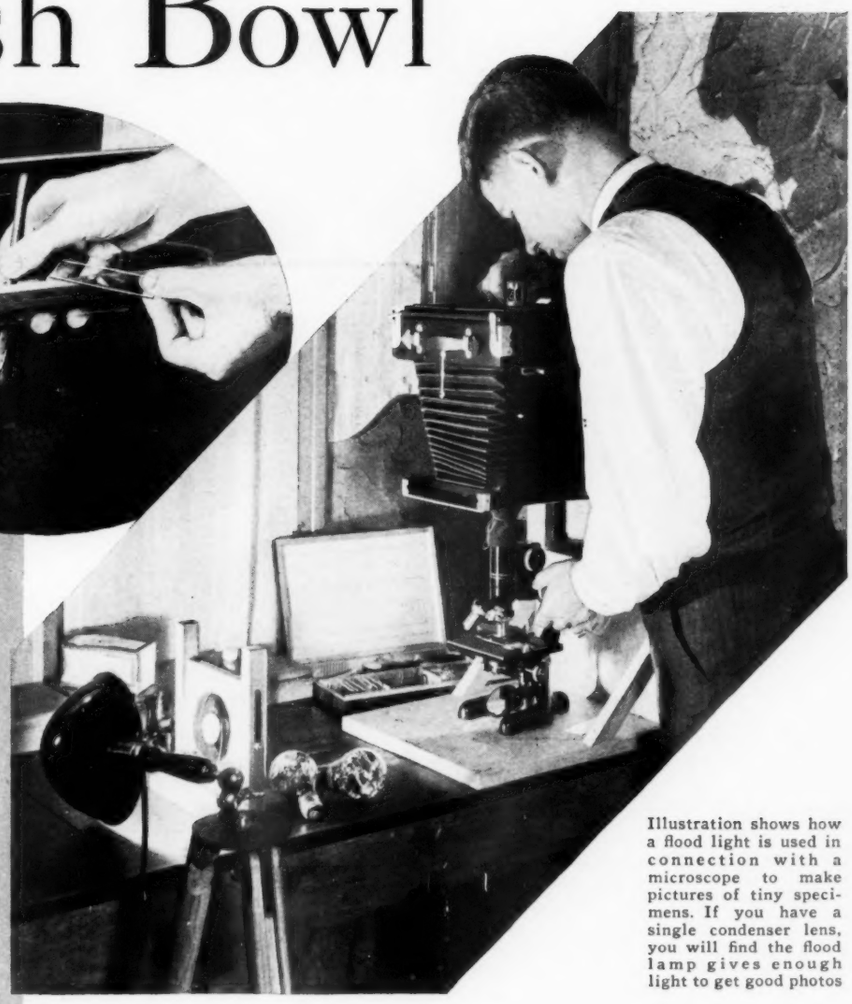


Illustration shows how a flood light is used in connection with a microscope to make pictures of tiny specimens. If you have a single condenser lens, you will find the flood lamp gives enough light to get good photos

"Say, I believe Pete's dead," one of the three remarked suddenly. "He hasn't moved for a long time."

The observer at the microscope switched to a lower power, one that would include the whole fish in the field of view.

"I think you're right," he said, after several seconds of peering. "He doesn't seem to be using his gills."

"You can't blame him," one of the others declared. "He's probably used up all of the air that was trapped in those few drops of water."

"But his heart still beats," the observer said.

"Lots of animals are to all appearances dead long before their heart stops beating," another explained. "Or you can say that the heart beats long after the animal is dead, whichever you prefer. A frog is a good example. And also—"

"Look!" the explorer at the microscope exclaimed. "This fish has lice."

"Lice?"

"Well, maybe not lice. But he seems covered with tiny round things that look for all the world like balloon tires. They're scattered about over his body. Here are two on his eye."

"What magnification are you using?"

"Two hundred and fifteen diameters."

"Do they move?"

"Yes. It looks to me as if they have rows of tiny, vibrating legs around their inner and outer circumferences."

"Let me see," both of the others chimed.

For an hour the trio of fish-bowl explorers studied the creatures.

"Look like diatoms to me," one of them declared.

"But diatoms don't have legs to wave," another objected. "They're plants, you know."

"Here's one swimming around in the water!" the man at the microscope cried. "And how it can travel! Looks something like a doughnut tire with a dome-shaped hub sticking out, traveling sidewise."

None of the books on hand would throw light upon the mystery, so the eye-weary explorers finally called it a day, tossed the erstwhile Pete into a bottle of alcohol, and went their respective ways, determined to attack the problem the next evening. But when the next night rolled around they found so many other fascinating things in the aquarium that they neglected to resurrect Pete for further study.

So the wheel-like inhabitants of Pete's body remain a mystery. What are they? Perhaps you can answer the question. You cannot study Pete for he was thrown into the garbage can long ago. But you can buy a few cents' worth of baby fishes and explore them microscopically to your heart's content. They will be so fascinating that you probably will spend every evening for a week at it, even if you don't find any "lice."

The aquarium or common fish bowl, particularly if it is of the planted, balanced variety that has been in operation for several months, is truly a world of wonders. You *(Continued on page 97)*

LIGHT FOR MOTORISTS BURNS LIKE A FLARE

SERVING as a signal light for campers and a trouble light for motorists when a tire has to be changed at night, a compact chemical candle has just been introduced. When its top is removed and scratched across a striking surface on the box, the candle ignites easily. Wind or rain cannot extinguish the light, which burns for thirty minutes and resembles that of a railroad flare. Thus it not only lights the work but serves as a warning signal to other motorists. One or two of the candles, dropped in a tool box or camping kit, require little space and are instantly available when needed.

NEW METER GAGES LIGHT IN ROOM

SERVICE men of public utility concerns are now using a recently invented light meter to demonstrate to consumers what their actual lighting requirements are in each room of their homes. The instrument comprises a light-sensitive disk that generates its own electric current when illuminated, and a meter that registers the intensity of the light. By holding the meter above a bridge table, as shown above, for example, the electric firm's representative can show the players whether they are using sufficient light to save the players from danger of eye strain.

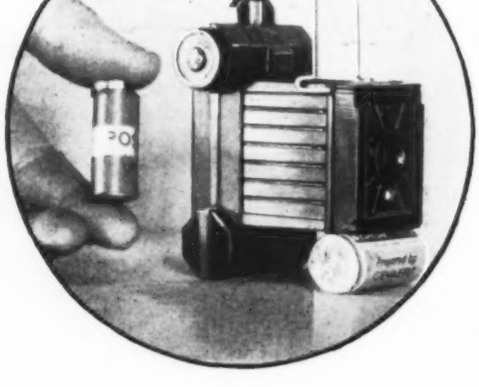
USE ELECTRICITY INSTEAD OF FOOD

CAN a light bath take the place of a square meal? Risking the censure of gourmets, a British authority, Prof. A. M. Low, boldly proposes that the energy consumed by the human body through an average day's activity may be replaced, at least in part, by electrical radiation instead of food. The illustration at the right shows him demonstrating how a future individual may dine on rays from an electric lamp instead of from dishes of choice viands, a prospect that may appeal less to lovers of good eating than to scientific minds. Nevertheless, Prof. Low maintains, the electrical form of refreshment has physiological advantages, "recharging" the body with available energy.

FULL MOTOR SERVICE FURNISHED BY PUMP

COMBINING a whole service station in a single fuel pump is the achievement of a British inventor, who recently exhibited his device at a motor show in London. It supplies fifteen brands of gasoline, fourteen brands of motor oil, Diesel fuel oil, compressed air for tires, plain water for radiators, and distilled water for batteries. In addition it provides vacuum cleaning service for the upholstery of the customer's car, tells him the correct time, and calculates the amount he owes.

Pump that provides full service for cars

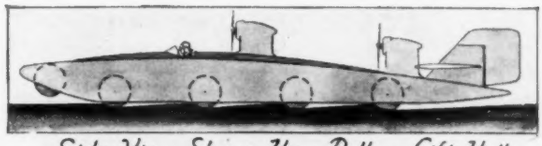


CAMERA SMALL ENOUGH TO HIDE IN THE HAND

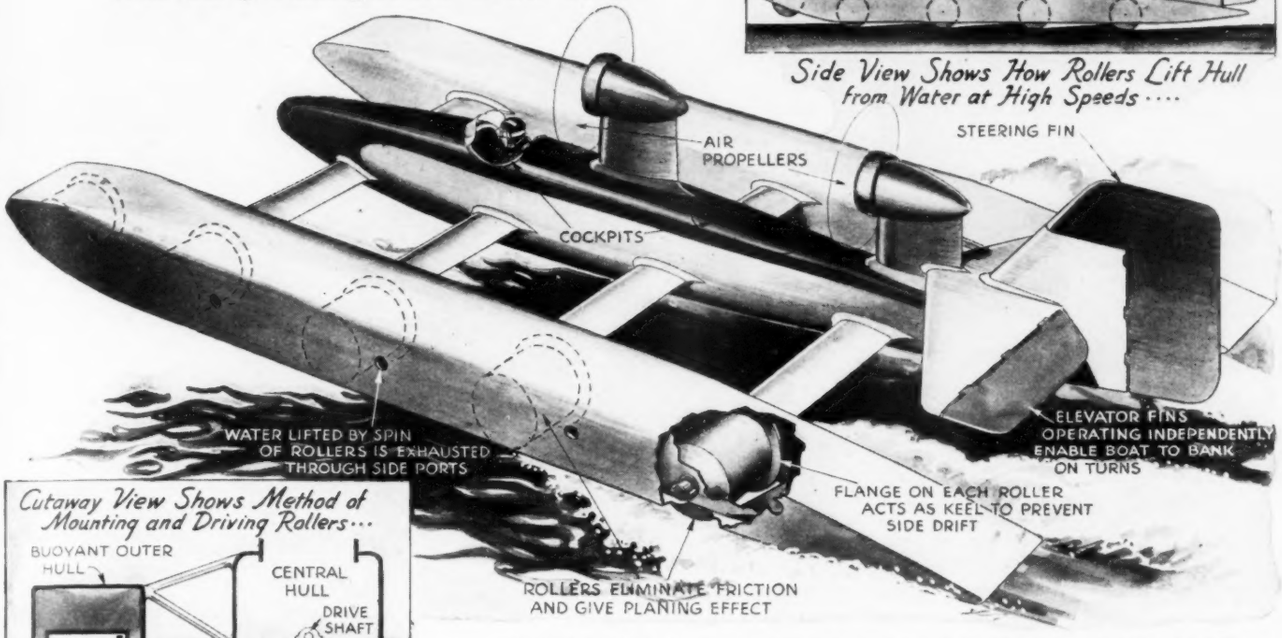
SO SMALL it may be hidden in the hand, a miniature camera shown at left, is said to take sharp, clear pictures one and one eighth by one and one half inches in size. Focusing is made unnecessary by the short focus of the lens, which permits portraits and close-ups to be made without the usual portrait attachment. The shutter is set to make snapshots alone, since these constitute the majority of pictures made by the amateur photographer. Because of its simplicity, the camera is unusually inexpensive. The photograph shows the midget size of the instrument and the roll of fine-grained film it uses.

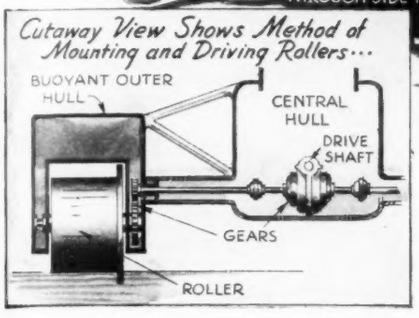
Boat on Wheels Aims at High Speed

Central Hull of Remarkable New Craft Will Carry Passengers and Power Plant



Side View Shows How Rollers Lift Hull from Water at High Speeds ····


AIR PROPELLERS
STEERING FIN
COCKPITS
WATER LIFTED BY SPIN OF ROLLERS IS EXHAUSTED THROUGH SIDE PORTS
ELEVATOR FINS OPERATING INDEPENDENTLY ENABLE BOAT TO BANK ON TURNS
FLANGE ON EACH ROLLER ACTS AS KEEL TO PREVENT SIDE DRIFT
ROLLERS ELIMINATE FRICTION AND GIVE PLANING EFFECT

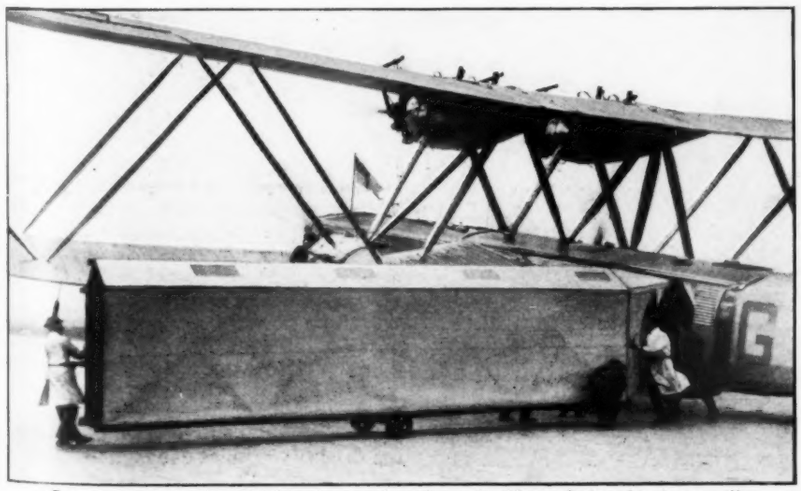


Illustrations show the construction and operation of the "boat on wheels." At left, diagram showing how the rollers are driven. Upper right, side view of the boat in water

PLACING a boat on wheels to make it ride over the water more swiftly is the proposal of a British inventor, who has designed, and patented in this country, a craft embodying the odd principle. Its pilot and passengers sit within a central hull that carries the power plant and the twin propellers that drive the boat. This hull rests upon two outer hulls, placed side by side in catamaran fashion. Each of the buoyant outer hulls is provided with a set of cylindrical rollers, which are geared to the power plant and are partially enclosed in recesses in the hull. At low speed the craft depends for its buoyancy upon that of the outer hulls, which ride low in the water. As the craft gains velocity, however, the speeding rollers tend to climb out of the water, and lift the hulls and the whole boat with them. In consequence, friction between the water and the hulls is minimized and a high velocity is attained. To enable the boat to be maneuvered at the speed its inventor expects it to attain, he provides at the stern, a rudder fin resembling that of an airplane. Elevator fins bank the boat when making a turn.

CANVAS GANGWAY SHIELDS AIR TRAVELERS

SO THAT air passengers may board a plane in comfort while the motors are being warmed up, and disembark without the sensation of stepping into a hurricane, a canvas hood that serves as a shield from the propeller blast has been placed in service at Croydon, England. Mounted on two wheels, the portable tunnel is trundled up to the door of an arriving or departing air liner as shown in the photograph, and is used like a gangplank by the passengers.



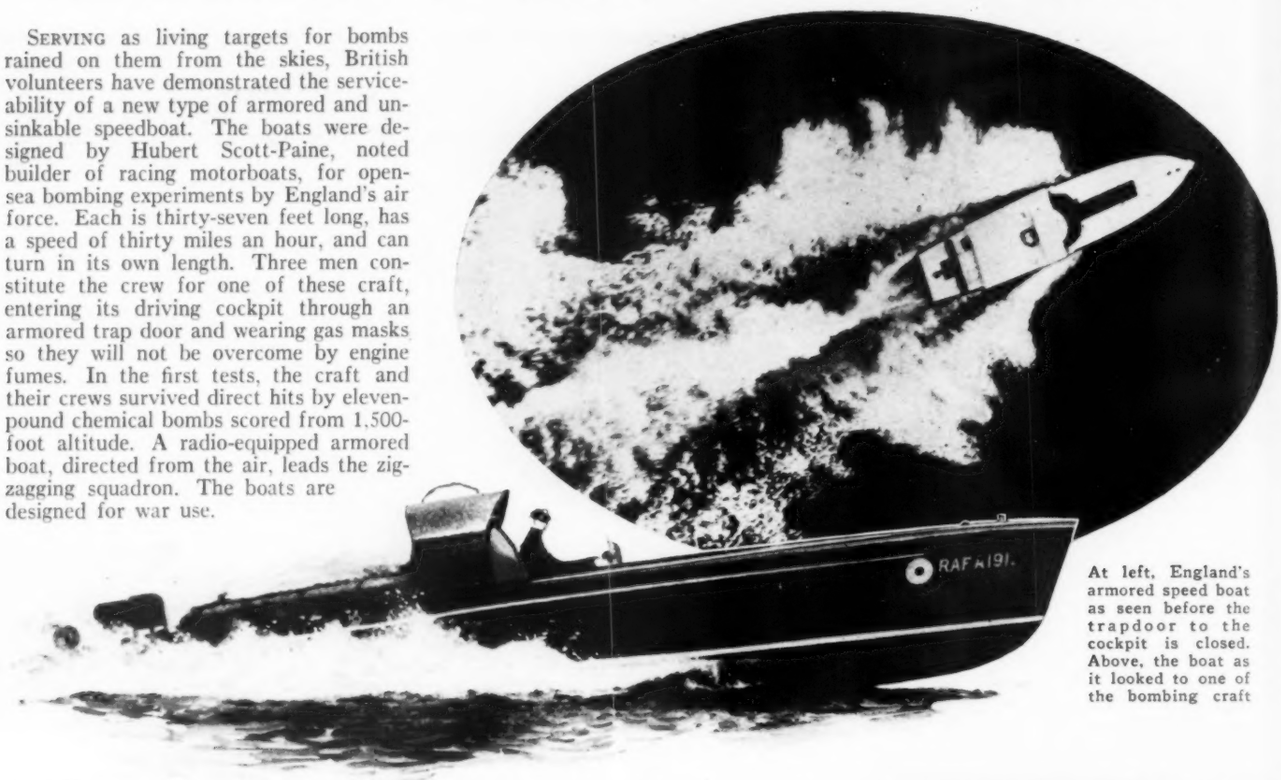
Canvas gangway that shields air travelers from the blast of the plane's propeller

ONE-WHEELED COASTER ROLLS LIKE A HOOP

A BOY who likes to roll a hoop may roll along with it, since a Vienna, Austria, engineer has invented a one-wheel coaster. The youthful passenger sits astride a seat within the odd vehicle. This seat, supported by a roller, is stationary, the rim revolving around it.

SAILORS MAN NEW ARMORED BOATS AS PLANES BOMB THEM

SERVING as living targets for bombs rained on them from the skies, British volunteers have demonstrated the serviceability of a new type of armored and unsinkable speedboat. The boats were designed by Hubert Scott-Paine, noted builder of racing motorboats, for open-sea bombing experiments by England's air force. Each is thirty-seven feet long, has a speed of thirty miles an hour, and can turn in its own length. Three men constitute the crew for one of these craft, entering its driving cockpit through an armored trap door and wearing gas masks so they will not be overcome by engine fumes. In the first tests, the craft and their crews survived direct hits by eleven-pound chemical bombs scored from 1,500-foot altitude. A radio-equipped armored boat, directed from the air, leads the zig-zagging squadron. The boats are designed for war use.



At left, England's armored speed boat as seen before the trapdoor to the cockpit is closed. Above, the boat as it looked to one of the bombing craft

Ship left balanced on a rock by a receding high tide

HIGH TIDE PUTS SHIP ON TOP OF ROCK

WHEN an unusually high tide occurred at the treaty port of Amoy, China, a few weeks ago, it left in its wake one of the world's strangest shipwrecks. During the night of the high tide, the crew of a small Chinese junk had anchored it unwittingly above a large rock hidden by the waters. The receding tide left the boat perched high and dry upon the rock, as perfectly balanced as if it were purposely set there. The unusual photograph shows the hapless crew still aboard their marooned craft, waiting for another abnormally high tide to cover the rock and again float the ship.

GLOW CAUSED BY LAMP IDENTIFIES MINERALS

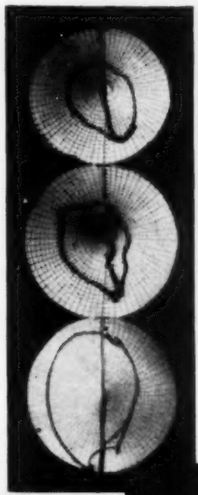
RECENTLY demonstrated in New York as a modern aid to the prospector and mining engineer, an ultra-violet lamp has been designed especially for the testing of samples of minerals. Under its rays the specimens glow or fluoresce, in the dark, each with a brilliant and characteristic color. Thus by noting whether a certain mineral has a blue or a green glow, an observer may quickly differentiate between two ores of similar appearance that could otherwise be distinguished only by a long-drawn-out chemical analysis. According to the maker, the apparatus is also adaptable for educational use, and may be employed to demonstrate fluorescence in the classroom.

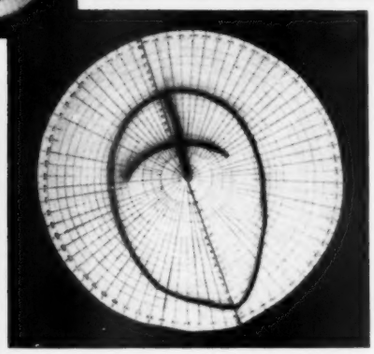
ABRASIVE COMPOUND IN NEW CIGARETTE LIGHTER

BY USING the electrical resistance of an abrasive compound to make it glow when current is passed through it, a manufacturing firm of New York has produced a new kind of electric cigarette lighter When the plug is connected to any household outlet, the user simply presses a button to obtain a light. The simple heating element has no parts to get out of order, and is said to cool off almost instantly after use.

Instrument Exposes Fake Cripples

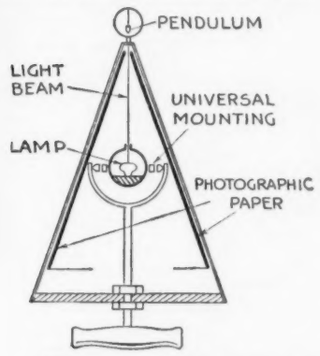
KNOWN as a "perigraph," a new instrument, declared to be the first of its kind, charts scientifically the ability of a person to flex his head or limbs in any direction. Thus it enables a surgeon to follow the recovery of a patient from an injury handicapping the use of one of his members; or, in a law court, it is said to unmask a faker with a pretended injury. The cone-shaped device is grasped in the patient's hand, if his wrist is to be examined, and held in a vertical position by a small pendulum in a ring at the cone's tip. Then the patient turns his wrist in every possible position, as far as it will go. Meanwhile a small lamp inside the cone, so hung that it always casts a narrow pencil of light vertically, traces a line around a conical chart of photographic paper lining the shell. When developed, the chart shows precisely the limits of movement. Attachments adapt the instrument to test the head, knee, or foot. No one faking a crippled limb could escape detection, the makers declare, since it would be impossible for him to make two successive records that would tally exactly in every detail and thus his faking would be instantly exposed.





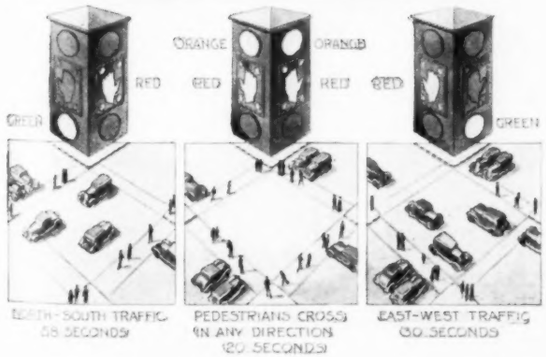
Photos above show use of new instrument that registers movements of head or limbs and exposes fake cripples

Left, perigraph's record of normal head-movements. Below, diagram showing construction of the perigraph



TRAFFIC LIGHTS STOP ALL CARS FOR PEDESTRIANS

Now under trial in New York City, a new traffic-control system gives the pedestrian a long-awaited opportunity to cross the street in safety. The traffic signal used has a glowing red hand that takes the place of the conventional red lens, and for twenty seconds during each cycle of traffic the red hands shine in both directions. During this period all cars must stop, even left and right-hand turns being prohibited; and orange lights, glowing above the red hands, inform the pedestrians that they may cross unhindered. The lower lens of the signal is the conventional green light for auto traffic. Diagrams at left show the three principal indications given by the signal, which, with three brief intermediate changes, complete the entire cycle.



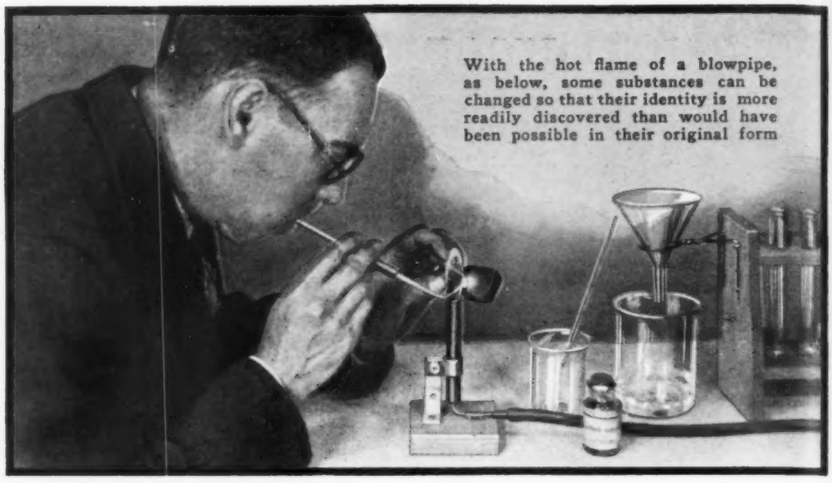
Upper left, installing one of the lights that stops all cars and gives pedestrians right of way. At left, three views of the signals as now installed

Working with a microscope, the bones of a tiny dinosaur are being put together by Barnum Brown of the American Museum of Natural History

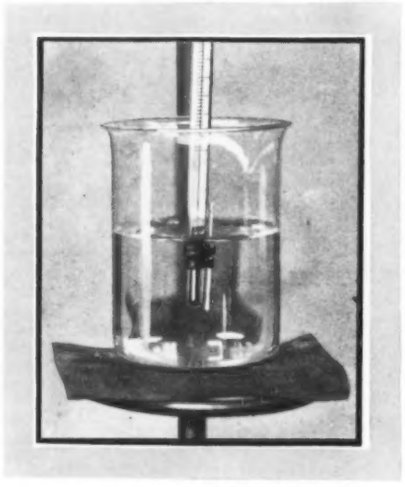
DINOSAUR BONES PUT TOGETHER UNDER LENS

BONES of a pygmy dinosaur, so delicate that they must be handled beneath a microscope lens, are being assembled by Barnum Brown of the American Museum of Natural History to give paleontologists their first glimpse of what this newly discovered, carnivorous species looked like. The lucky find was made in Montana last October, when a natural cache of more than 100 bones was discovered.

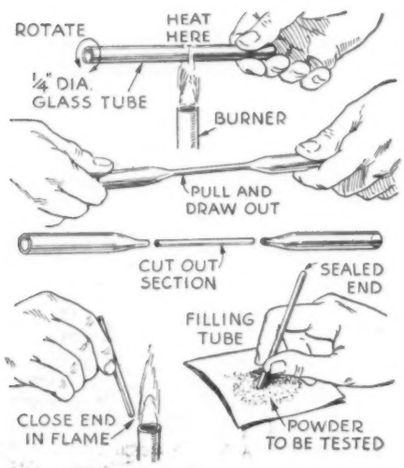
Home Laboratory Tests of Household Chemicals



With the hot flame of a blowpipe, as below, some substances can be changed so that their identity is more readily discovered than would have been possible in their original form



Heating a substance in a beaker, as above, and using a thermometer to get the temperature at which it melts, often will give the home chemist a clue that will enable him to identify it with accuracy



This illustration shows how a container is made from a glass tube so it can be attached to thermometer as is shown in upper photo

HAVE you ever wondered what chemicals lie hidden in the everyday substances you use around your home? Are they safe? Are they worth the price you pay for them? Simple tests in your own laboratory will reveal the answers.

Perhaps you are skeptical of some new brand of gasoline. You may wonder whether it contains impurities that will corrode the velvet-smooth surfaces inside your motor. To answer this, you need only perform the standard gasoline corrosive test developed by expert industrial engineers and chemists to control the quality of their products.

Simply place a brightly polished strip of sheet copper in a large test tube and pour in enough of the gasoline to cover the metal. Then place the test tube in a hot-water bath, heated to 122 degrees Fahrenheit, for three hours. At the end of that time, inspect the surface of the strip. If it has become discolored, the gasoline has failed to pass the test. Government specifications require that the copper must be free from discoloration if the gasoline is to be classed as "non-corrosive."

SINCE it will serve for many other experiments as well as your gasoline tests, it will pay you to make a water bath similar to the one shown. Consisting mainly of a large can (a slip-on top coffee can will do), a small can without a top, some metal tubes, and several lengths of rubber tubing, it is a simple piece of apparatus to make. Of course the various joints between the tubes and cans must be tightly soldered so as to be water-tight.

In use, water is allowed to flow into the bath through the U-shaped inlet tube hooked over the rim of the small can. From there, it flows into the larger can which serves as the heating chamber. When the water level in both cans reaches the mouth of the adjustable outlet tube projecting up through the bottom of the smaller can, any excess flows off through the exit tube to the drain. In this way, the water automatically is maintained at a constant level.

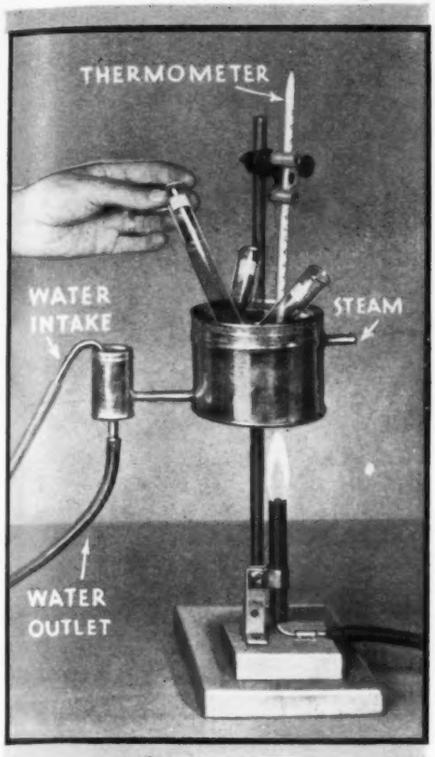
A two-inch hole cut in the slip-on top of the coffee can receives the specimen tubes to be heated and a chemical type thermometer for measuring the temperature. The larger can is supported on a ring stand and is heated with a gas burner. By varying the flow of water and the gas flame, you can keep your water bath at a constant temperature. This simple piece of apparatus also is valuable for drying chemicals or evaporating solutions.

IN the field of cosmetics, the amateur chemist can do a great deal of valuable experimenting. Naturally, purity and safety are important factors in any sort of lotion, powder, or cream that is applied to the skin.

Although most cosmetics are entirely harmless, creams sold for the removal of wrinkles and freckles sometimes contain a compound of mercury which, after continued use, is absorbed by the skin. To test a cream for mercury, heat a small quantity of it with strong nitric acid. This will convert any mercury present into its soluble form. Then heat the mass to get rid of any excess acid, dilute it slightly with water, and immerse a strip of copper in the solution that results. If any mercury is present, it will amalgamate with the copper (P. S. M., Jan. '34, p. 50) and be plainly visible. A face cream containing mercury is usually branded "not recommended" by the analytical chemist.

Silver also is an easy metal to detect when it is hidden in some complex substance. For example, it is a simple matter to prove that silver is contained in the emulsion of a photographic negative. Simply place the film in warm water for several hours to soften it and then scrape off a small quantity of the coating.

By heating this softened emulsion with nitric acid, you then change any silver present into silver nitrate. Continue to heat it gently to drive off the excess acid and then filter it. Finally, add a drop or



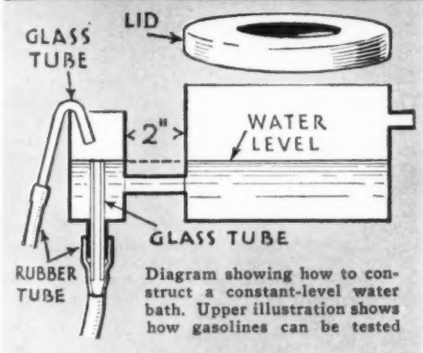


Diagram showing how to construct a constant-level water bath. Upper illustration shows how gasolines can be tested

What Are the Contents of the Everyday Things You Constantly Handle? Simple Experiments Described in This Article Will Help You to Answer That Question

By RAYMOND B. WAILES

two of hydrochloric acid or salt water to the filtered solution. This will form a white precipitate of silver chloride which can be identified by the fact that it will turn bluish-gray when it is placed in a bright light. This same process can be used to detect the presence of silver in almost any substance.

To test styptic pencils and perspiration-allaying liquids for aluminum, simply add ammonium hydroxide to the actual solution or to the water solution if it is a solid. This will precipitate out aluminum hydroxide if aluminum is present. Wash the precipitate by decantation and filter it off.

THEN, to prove the presence of aluminum, place some of the jellylike substance on a small charcoal block and heat it with the intense blue flame from a blowpipe. This will change it into alumina or aluminum oxide which, when moistened with a drop of cobalt nitrate and again heated, will take on a characteristic blue color indicating that the original substance contained aluminum. Metal foils suspected of being made of aluminum or having aluminum in them can be tested in this way by dissolving them in nitric acid and treating them with the ammonium hydroxide (ammonia water) as before.

There is, however, a recognized procedure that must be followed in making this flame test. Adjust your gas burner to deliver a yellow flame (no primary air) about an inch or an inch and one half long. A blast of air is then blown through the flame with an ordinary mouth blowpipe. This will convert the almost passive yellow flame into an intensely hot and pointed blue flame. The spout from an old oil can, fitted with a short length of glass tubing, can be used as a blowpipe.

MANY mouth washes, eye baths, and hair-washing preparations contain the element boron. Its presence in these solutions is beneficial. To test a solution for boron, simply mix a small amount of the substance with some hydrochloric acid, add some rubbing or similar alcohol, and ignite the mixture. Enough alcohol should be added to make the mixture flammable. If a greenish-blue flame is present at the moment of ignition, you can be fairly sure that the original substance contained boron. You can repeat the test by extinguishing the flame and relighting it. Remember that the greenish-blue color must be present at the moment that the mixture bursts into flame.

To test chemicals for their identity, the amateur chemist can make good use of the simple flame test that we used several months ago (P. S. M., Mar. '33, p. 56). Recently, the writer used the flame test to determine the composition of a simple household cleaner.

The substance was used to wash woodwork and windows, to clean paint brushes, and as a general cleaning agent around the house. A bit held on a wire in a gas flame gave an intense yellow flame. This immediately indicated the possibility that the material was, or was composed of, some compound of sodium.

To determine more about the substance, a glass tube was held in the flame, softened, and then pulled apart until a tube of needlelike diameter was formed. This was broken off and one end sealed over to make it airtight.

A small amount of the cleaner then was ground to a powder with a mortar and pestle and packed into the tube. When the tube was filled it was fastened to the bulb of a chemical thermometer and immersed with the bulb in a water bath that was heated slowly. Being close together, both the thermometer and the powdered cleaner were maintained at the same temperature.

Watching the thermometer and the powder closely, the exact temperature at which the substance melted was noted. It was seventy-seven degrees Centigrade. Chemical tables revealed that tri-sodium phosphate had that melting point.

THAT the substance was a phosphate finally was proved by making a solution of it by adding nitric acid and some ammonium-molybdate solution. Gentle heating developed a yellow precipitate, indicating the phosphate radical.

The flame and melting point tests can be used to determine the identity of many other substances. However, for materials whose melting points are higher than 100 degrees Centigrade, strong sulphuric acid, salt water, or paraffin oil is used as a bath.

It is a simple matter to test for the presence of a sulphide in a depilatory cream. In the first place, your nose will tell you almost instantly that hydrogen-sulphide gas is present. As a positive test, hold a white strip of paper, moistened with lead-acetate solution, near the cream. If hydrogen sulphide is present, the paper will turn brown or black.

Iron is a rather simple substance to detect. You can identify it in any tonic, either pills or liquid, by dissolving the substance in hot water to which some nitric acid has been added. After the solution has been filtered, add one or two drops of sodium or ammonium sulphocyanate to the filtrate (resulting solution). If iron is present, a red color will form.

By adding an acid to a substance such as cleansing powder, chalk, or whiting, you can test for a carbonate. If it bubbles or effervesces a carbonate is present.

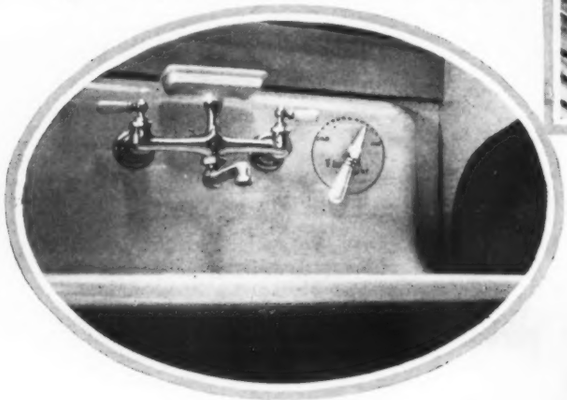
A simple test for detecting the presence of aspirin in everyday substances is to dissolve a bit of the material in ammonium hydroxide. Then add two or three drops of copper-sulphate solution and mix in some hydrogen peroxide. If a reddish-orange color forms on warming, aspirin is present. *(Continued on page 108)*

A bit of paper, moistened with lead acetate, will turn black, when brought close to even the slightest trace of hydrogen sulphide

Newest HOUSEHOLD Inventions

NEW PRESSURE COOKER. Two features distinguish this new pressure cooker. Food may be cooked within it on ledges of various size, removed, and served directly at the table. Also, the hinged cover is held down by a spring clamp which lets steam escape when pressure rises above the desired point

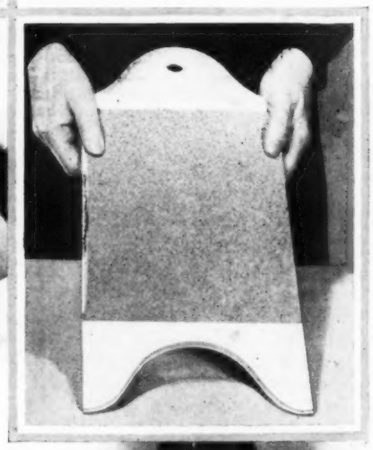
POWDER INSIDE CLEANER When this rubber cleaner is dipped in water the powder it contains is dampened and permits the ready cleaning of automobile windows, windshields, and glass in head lights



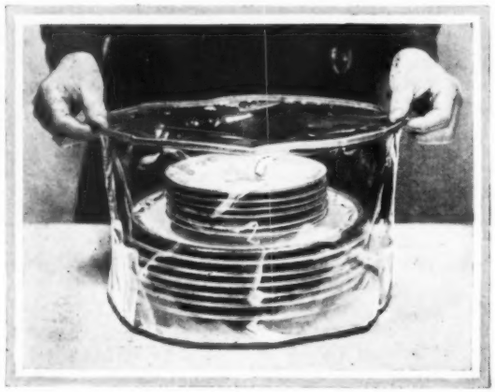
CONTROLS HEAT OF WATER. The faucet control, shown above, automatically mixes hot and cold water to give desired temperature. The pointer is set to required heat and the volume is then controlled by handle in the ordinary way

FREES ICE TRAY. With this handle, ice-cube trays are instantly released as the handle acts as a releasing lever

TEA-MAKING SPOON. A sliding cover, that has no hinges, closes this tea-making spoon. The cover fits tightly and can not come loose while being used

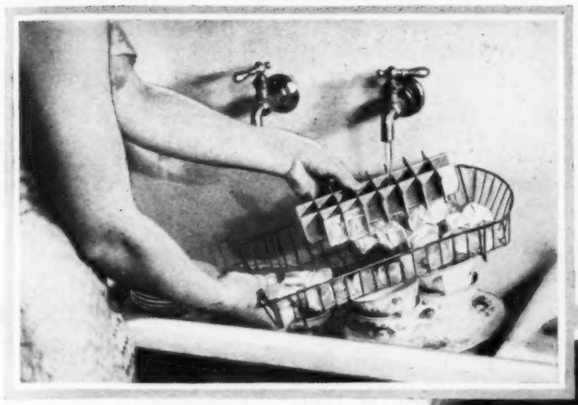


SINK SCOOP. Scraps of refuse are easily removed from a sink with the aid of this scoop. The jaws are opened merely by pressure of the finger tips



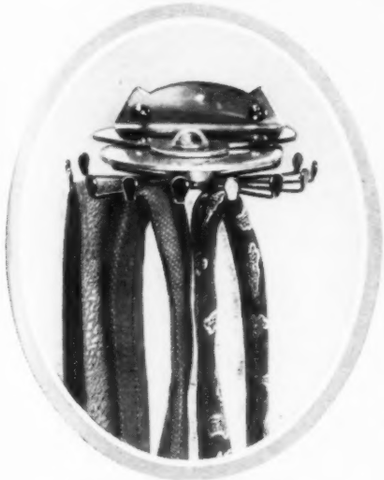
CELLOPHANE FOR CHINA Dust is kept from china by means of the cellophane cover shown at the right. The covers also can be used to keep cakes moist and clean

WASHBOARD THAT WRINGS OUT The surface of this washboard is made of rubber and can be removed so the water can be wrung out of it. The board is intended for use in washing gloves, lingerie, laces, and all else requiring careful handling



PROTECTS YOUR HANDS. With the basket shown at left, ice cubes are removed without chilling the hands. Tray is held beneath faucet and the basket catches the frozen cubes

KEEPS WATER IN SINK. This rubber sink stopper fits any sink and keeps water in sink while you are using it

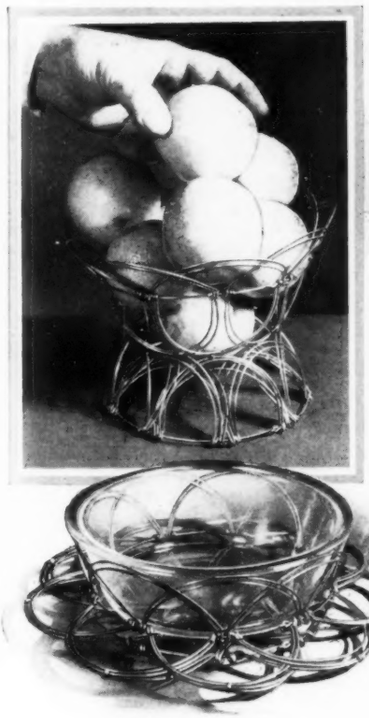


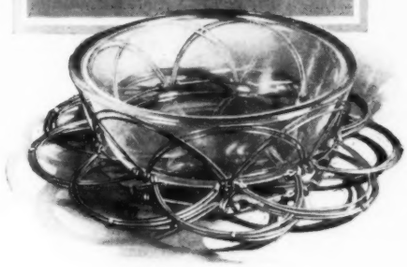
TINY NIGHT LAMP. The finest wire filaments ever developed are used in this night lamp which gives a light comparable to that of moonlight and costs little

BURNS PERFUME. A molded clay wick in this deodorizer draws perfume up to an asbestos burner that glows red and releases perfume into the room

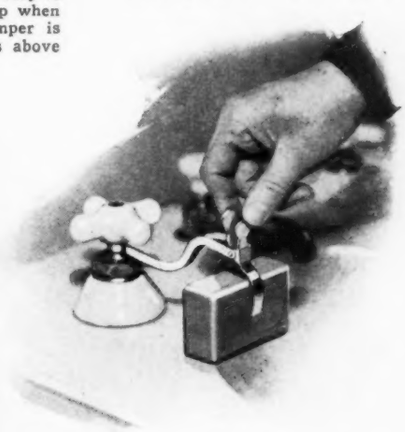
REVOLVING TIE HOLDER. Selection of a tie is easy from this moving holder that exposes each tie

MOP BUMPER. It is easy to shake dust from a mop when this rubber-tipped bumper is attached to handle, as above





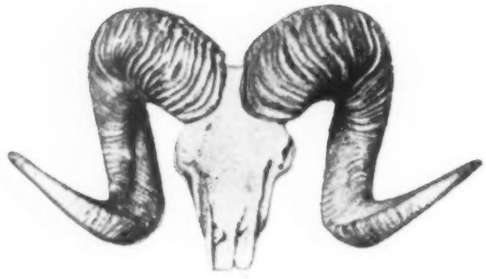
VERSATILE WIRE HOLDER. The user is amazed at the variety of forms this wire holder will assume. By folding it you can have a fruit stand, a hot dish holder, an electric-light socket or a baking plate holder, as seen in photos above

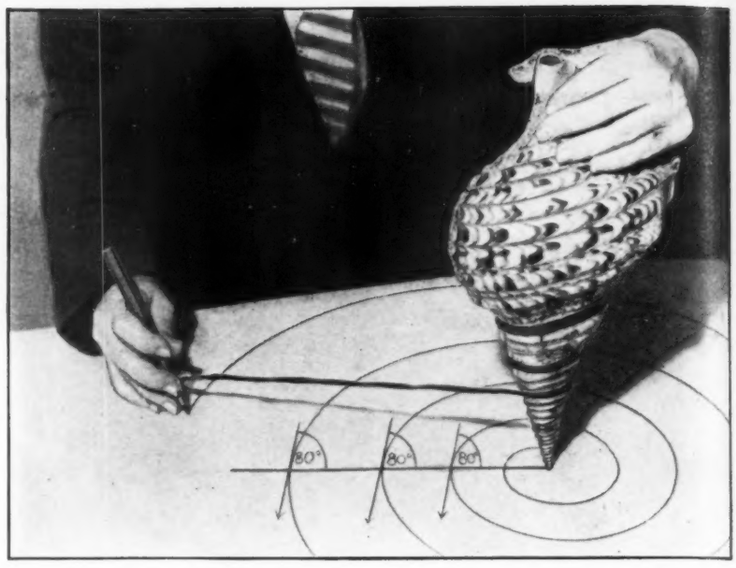


NEW TYPE SOAP HOLDER. Mussy soap dishes are eliminated by the soap holder, above, that clamps readily to any faucet

SUPPORTS FLOWER POT. A secure support for a flower-pot is provided by the metal holder seen at left. It slips between window and sill and is held in place by two small nails, easily inserted

Why NATURE GROWS THINGS IN *Spirals*





Draw a line, as above, by unwinding tape from the grooves of a snail's shell. In this way a perfect spiral will be formed. Study of the figure shows that nature uses this form because it permits indefinite growth without change of shape. At left, horns that furnish a splendid example of this spiral form of growth

NATURE likes to grow things, from microscopic shells to stupendous spiral nebulæ, in the form of a spiral. To draw a spiral, and at the same time solve this mysterious tendency of nature's, follow these simple directions:

Take any pointed shell. An ordinary snail shell will do. Fasten, with a bit of adhesive tape, a piece of string at the start of the spiral groove near the large end of the shell. Then wind the tape in the spiral groove right down to the point.

At this end of the tape make a loop and insert the point of a pencil. Then, with the shell held point down upon a large sheet of paper, unwind the tape round and round, at the same time drawing a line with the pencil.

The result on the paper will be the kind of spiral nature uses in shells, many flowers, horns of animals, spiral nebulæ, and so on.

This shell-drawn spiral has a remarkable property: it expands in such a way that an object, growing along its curves, can become indefinitely larger without changing its shape. As an illustration:

To a little triangle "A," shown in the drawing at upper right, add the piece "B," and produce a larger triangle of the same shape. The angle is seventy-five degrees in the small triangle and it remains seventy-five degrees in the larger one.

Now apply this to a spiral shell. To the spiral shell A the piece B grows on. The added part produces a larger shell of the same shape. Like the triangle, it remains the same shape because the angle between the shell's direction of growth and its extending base-line remains the same. This is why the spiral of growth in nature is called the equi-angular or logarithmic spiral.

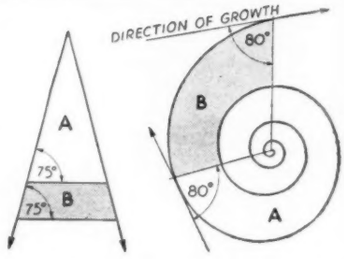


Diagram showing how a triangle or a spiral shell can be indefinitely enlarged without changing the shape. The shaded portions in each drawing were added but the original shape, as is clear, remains the same in spite of additions

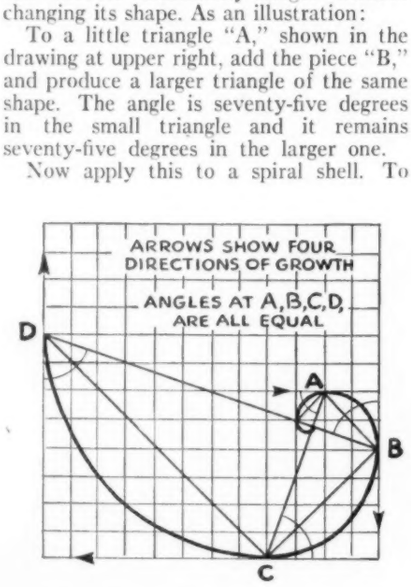


Diagram above shows how spiral of growth can be drawn on cross-section paper without the aid of a shell. After the framework is drawn, the curve is put around it freehand

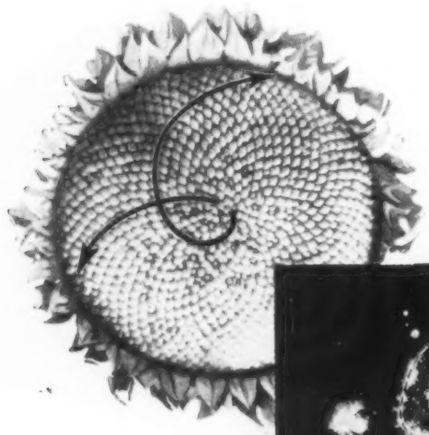
This equi-angular spiral is the only curve that enables a structure to grow larger without changing its shape. This is why the curve is found in so many of nature's creations.

It will be interesting to see how nature applies it in a few instances:

The seed-disk of a sunflower must get larger in all directions at once. It must remain circular while it grows. Accordingly, nature uses a great many equi-angular spirals of growth.

The spiral nebula, however, grows along two arms thrown out from the whirling central mass of gas. Accordingly, only two spirals of growth are found in it.

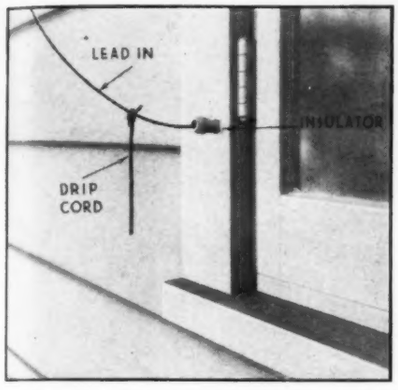
If you wish to draw a spiral of growth without the aid of a shell, you can do it with a piece of quadrille-ruled, or cross-section paper. Start your spiral at any crossing of two lines and make each side of the straight-line framework twice as long as the preceding one. The curve is drawn in free-hand around the framework. At each of the points A, B, C, and D, in the drawing in the center column, you will find that the direction of growth makes the same angle with a line to the spiral's center.



In the sunflower, are combined many spirals of growth to enlarge the area of the seeds. Two of them are shown above

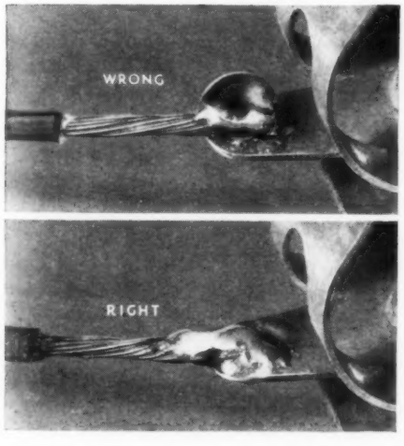
At left, spiral nebula which grows along two arms thrown out from the whirling central mass of gas. In this form there are two spirals of growth

Keeping Your Radio in Order



Keeping Lead-in Wire from Bringing in Rain

AFTER having little success with the usual methods of preventing rain water from running down my antenna lead-in wire in such quantities that it would flow through the insulator onto the sill of the window, I hit upon the simple kink shown in the photograph above. First, I arranged the wire so that it would approach the window in a gentle arc. Then, I tied six inches of stout cord to the lead-in wire about three feet from the window, making the knot in such a way that one end hung down about three or four inches. Now, any water that flows along the wire, catches on the string and drops harmlessly to the ground. Incidentally, this kink will work just as well in cases where heavy rain causes water to travel down the wire and through the flat lead-in strip that is sometimes used.—F. C.



Soldered Connections in Short-Wave Receivers

IF YOU have constructed a short-wave receiver and fail to get results, your connecting wire and soldered joints, rather than the hook-up itself, may be at fault. Short-wave circuits are far more critical than those designed for the longer waves and too much resistance in the wrong place may upset the balance. If the circuit checks with the diagram, trace through the wiring and be on the lookout for unnecessarily long connecting wires and poorly soldered joints. Short-wave circuits that have given little or no response when first connected have been known to operate perfectly when long connections were shortened up and suspicious looking soldered joints were opened, cleaned, and resoldered. This precaution also holds true in troublesome short-wave converter units.—L. T. H.

HOW TO STOP LEAK FROM LEAD-IN WIRE—WORKING ON COMPACT SET

Emergency Repair for Noisy Volume Control

WHEN a wire-wound volume control gets noisy with age, it is possible sometimes to make an emergency repair with some alcohol, a soft rag, and a pair of pliers. Remove the main body of the resistance from the cabinet and rub the wires with a cloth dipped in alcohol. This will remove any dirt or grime that may be covering the contact surface of the wires. Then if the wires look worn where the rotating arm rubs, bend the arm slightly with the pliers to change the point of contact. Before replacing the unit, check up on the nut that holds the contact arm in place. Of course, if the wires of the winding are loose, this may be causing the noise and it will be best to replace the entire unit or at least the winding.—J. K.

Removing Tubes From Miniature Cabinets

BECAUSE of the many parts that must be crowded into miniature cabinets, it is difficult sometimes to remove the tubes from a modern compact or semi-compact receiver. This is especially so in cases where the tubes have been cemented or glued in place by the manufacturer. Tugging at the glass globe of the tube may result in the bulb and base parting company. To avoid this risk, the writer uses a cheap pair of ice tongs with sponge rubber pads taped to the prongs (potato lifters will serve as well). When a tube is to be removed from a crowded set, the improvised tongs can be lowered over the bulb and clamped securely over the base. A steady tug will pull the tube free and all the pressure will be applied at the strongest part of the tube.—K. D. P.

Small ice tongs, the prongs of which are covered with sponge rubber, is handy to remove tubes

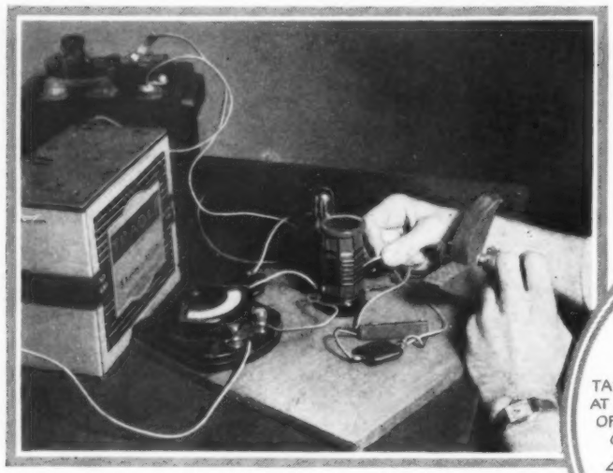
To Prevent Buckling When Bending Copper Tubing

WHEN bending thin-walled copper tubing for transmitter inductances, you may find it difficult to keep the metal from buckling. If reducing the pressure and bending tension on the tubing does not help matters, try filling the tube with sand. If sand is not close at hand, anneal a short length of copper wire that is a loose fit inside the tubing. Push this into the tube and pull it out bit by bit as the bending progresses, making sure to pull the wire free of each bend.—J. S.

How You Can Measure Resistance of Any Unit

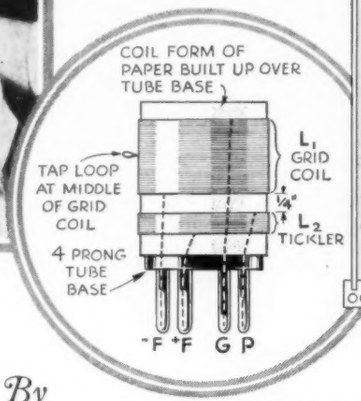
BY CONNECTING a known resistance, a 0-1 milliammeter, and a B-battery in series with two binding posts, you can measure the resistance of any unit. Simply connect the unknown resistance across the terminals and note the reading. Then by comparing this with the reading when the binding posts are shorted, you can figure the approximate value of the unknown unit. For example, if a forty-five volt battery and a known resistance of 45,000 ohms are used, the meter will read one milliampere when the binding posts are connected together. Then if an unknown unit, connected to the terminals, swings the needle to half of a milliampere, it indicates that the unknown resistance is equal to the known unit (the current is cut in half when the resistance is doubled).—R. S. E.

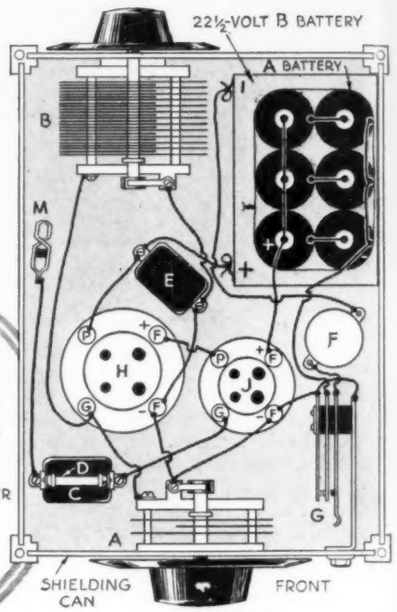
This Simple Monitor Checks Your Transmitter



With a bread-board layout of a circuit, above, find the position for the center tap on grid coil. Then move grid connection to find where circuit goes into oscillation

Illustrations, right and below, show the wiring and arrangement of parts in a simple monitor. Plug-in coils are made by building up a four-prong tube base with a roll of stiff paper





By

George H. Waltz, Jr.

DESIGNING and building a short-wave transmitter to send messages on certain wave lengths is one thing, but keeping it tuned within those bands is another.

Until you can boast of some means for adjusting your transmitter to known frequencies accurately, your amateur station will not be complete. Operating a transmitter without tuning it is like firing a rifle without aiming it—the results are just as haphazard and dangerous. If you allow your set to send out waves outside the regular bands, the Government may revoke your license, confiscate your equipment, or impose a heavy fine.

Many amateurs rely on homemade or factory-built wave meters to check their sets and hold them within the specified bands (P. S. M., Sept. '32, p. 54). Generally, these meters consist of a coil of wire and a variable condenser coupled with some device, a flashlight bulb or a milliammeter, that will indicate visually when the transmitter's frequency is adjusted.

As a check on the frequency, the wave meter does a good job, but accurate tuning is only one of the requirements of a good sending station. To the amateurs who listen to your signal, clearness, steadiness, and lack of interference will be of equal importance. To gain the approval of both the government and your brother amateurs, you must use some arrangement that will check the quality as well as the wave length of your signal. Such an arrangement is called a monitor.

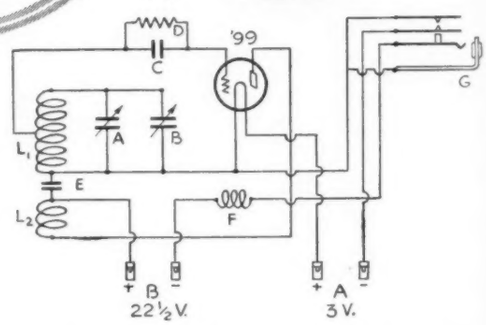
A monitor is merely a simple shielded oscillator housed in an aluminum cabinet. In reality, it is in most cases a fixed-frequency receiver having a variable condenser used, not as a tuner, but as a means to indicate the slightest departure of the monitored transmitter from the desired frequency.

If a monitor is to hold the calibration that will make it serve as a check on the transmitter, it must be constructed rigidly. To be really effective, its calibration must be more reliable than that of either the receiver or the transmitter. The condenser must be sturdy. The coils must be rigid. And the entire circuit must be designed and constructed with a thought given to stability.

Being simple, the monitor for your station need not be expensive. If you have a 199 tube in your junk box, the monitor shown in the drawings can be constructed almost entirely from spare parts.

Although specific ratings are given for the condensers, small variations one way or the other will make no great difference. In fact, the specifications given here should serve only as a guide. Even the coil windings may have to be altered slightly to give the proper spread under existing conditions.

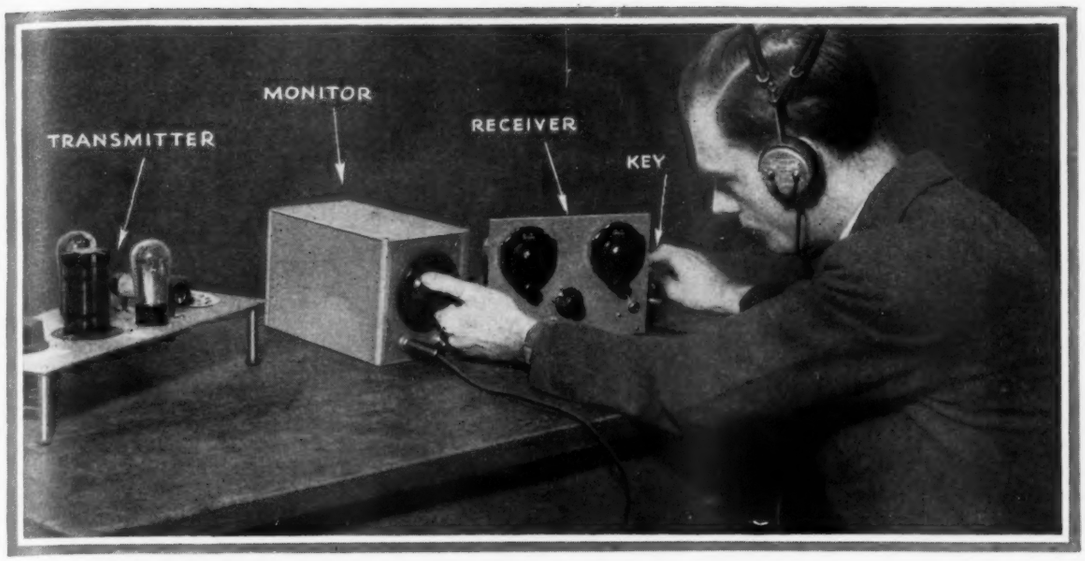
As shown in the diagrams, the circuit consists of a tube, a grid leak and condenser, two variable condensers, a filament-control jack, a small fixed condenser, coil or coils depending on the band or bands to be covered by the transmitter, two sockets, and a radio-frequency choke.



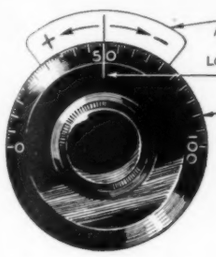
Wiring diagram for the monitor circuit. Specifications for the parts are given on the opposite page

The battery supply, which is contained in the aluminum-shielding can that forms the monitor's cabinet, consists of a twenty-two-and one-half-volt B-battery and a small three-volt A-battery made up by assembling six one-and-one-half volt flashlight cells and connecting them in series-parallel.

The plug-in coils to cover the band or bands on which the transmitter operates can be wound on the four-prong bases of discarded tubes. To obtain a longer coil surface, the tube base can be lengthened with a cylinder of heavy paper. Butt the top edges of two tube bases together, wrap a wide strip of paper around them to form a tight cylinder, and apply cement to the edge. Then, when the cement dries, remove one of the tube bases and cement the cylinder to the remaining base. To stiffen the form, coat it with



With the monitor seen at left, the amateur can check the frequency of his signals and also listen to the quality of his outgoing signals



An indicating mark is scribed at the "fifty" division of the dial for the condenser A, and a mark is also placed on aluminum panel

shellac and wind the wire in place while the shellac is tacky. This will help to hold the wire in place and make the coils more rigid.

As shown in the circuit diagram and in the drawing of the coil, the grid coil (larger coil of the two) is supplied with a tap. In most cases this tap should be located just about in the center of the winding. Although it serves to reduce the transmitter's loud signal to a comfortable level, the main purpose of the tap is to increase the frequency stability.

In reality, the tap should be placed at the lowest possible turn on the grid coil that will still allow the circuit to operate. In most cases this will be about the center turn, but if you desire to get the exact point, rig up your circuit, bread-board fashion, as shown in the photograph. Then, by moving the grid connection along the turns, you can determine at which turn the circuit goes into oscillation. You can do this by listening with earphones or by watching the needle of a milliammeter. The whole purpose of the test should be to determine the point of least coupling that will allow the circuit to oscillate.

Incidentally, if you have a set of commercial short-wave coils that are not in use, you can make use of them in your monitor. In most cases, because of their rigid construction, they will be better from a calibration standpoint than the homemade variety.

Unlike many monitors, this particular arrangement makes use of two variable condensers connected in parallel. One, mounted at the rear of the aluminum-shielding can, serves as the main unit, and the other, mounted on the front panel, acts as a vernier adjustment. Zero to one hundred dials should be used for both but the vernier dial should be supplied with a long indicating line at the "fifty" mark and should be mounted under an arrow marker and plus and minus signs scribed on the front panel.

Condenser B should be fitted with some sort of locking arrangement that will allow it to be held in any one position. A V-shaped slice of rubber that can be wedged between the aluminum panel and the condenser dial will serve the purpose.

The first requirement of your monitor is that it oscillate. Then with the pair of earphones you intend using with the monitor plugged into the filament jack, you are ready for the process of finding the approximate centers of the bands you intend working with your transmitter.

By logging various marker stations in the desired band on your short-wave receiver, you can tell with fair accuracy just about what readings of the dials indicate the approximate center of the band. With the receiver set at this point and a second pair of earphones plugged into your receiver, insert the coil in your monitor and adjust the dial of condenser B to give the loudest oscillation in the receiver phones. During this operation, the dial of condenser A should be set with the long fifty marker line centered directly under the arrow indicator.

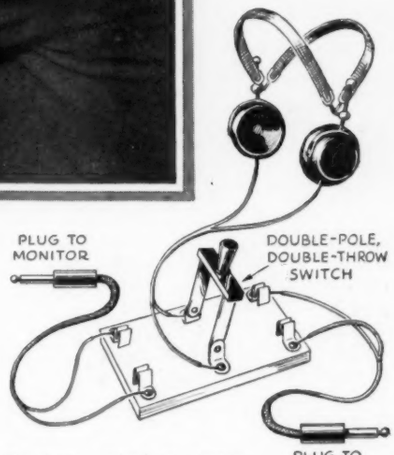
When the oscillation is heard, it will indicate that the monitor is tuned to the same point as the receiver. Lock the condenser B at this point with the rubber wedge or other arrangement and make a note of the reading.

You are then ready to use the monitor in checking the frequency of your transmitter to this same approximate point. Let us say, for example, that in adjusting the monitor to your receiver you found that the approximate center of the forty-meter band gave a reading of thirty-three on the large monitoring condenser. With the condenser *(Continued on page 113)*

LIST OF PARTS
for Homemade Monitor

A—*Variable condenser, 20 mmf.*
B—*Variable condenser, 140 mmf.*
C—*Grid Condenser, .00025 mfd.*
D—*Grid leak resistance, 1 meg.*
E—*Fixed condenser, .001 mfd.*
F—*Radio frequency choke.*
G—*Filament-earphone jack.*
H—*Four-prong socket for tube-base coils.*
J—*Four-prong socket for 199 tube.*
K—*Clip for connection on grid coils.*
L_1 and L_2—*Grid and tickler coils wound as follows:*

	Grid coil (L_1) No. 24 wire	Tickler (L_2) No. 30 wire
20 meters	5	4
40 meters	11	7
80 meters	22	9
160 meters	50	15



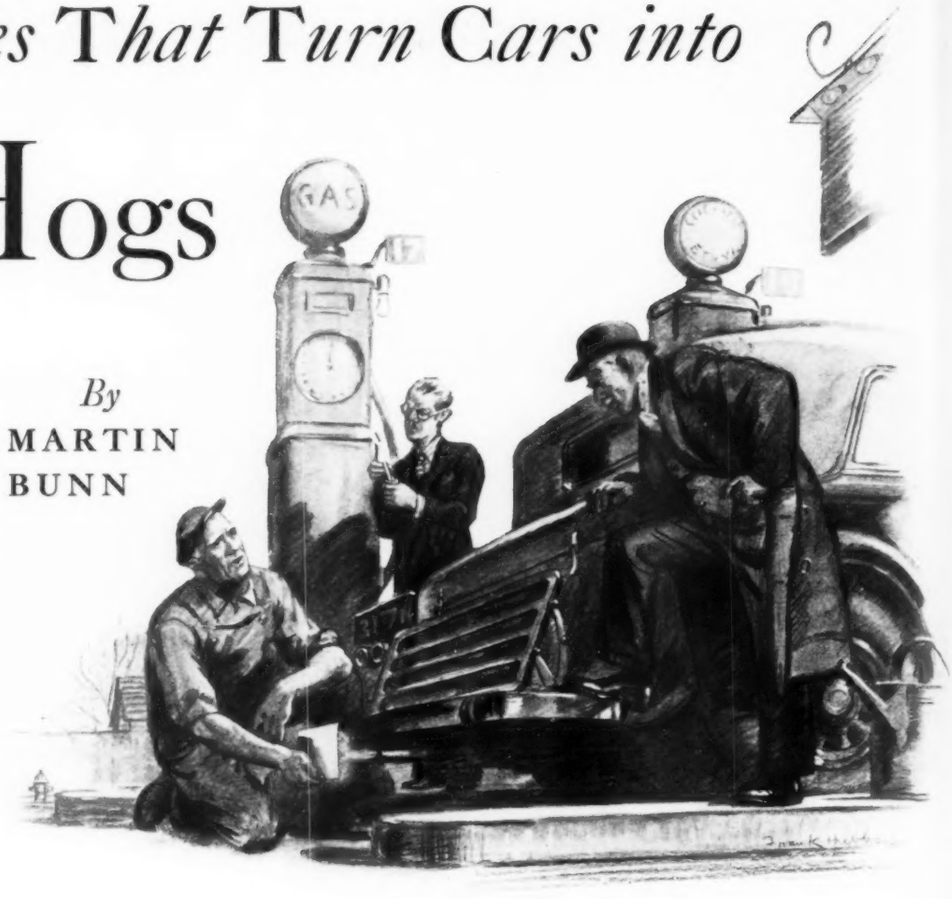
Earphones wired to center posts of double-pole, double-throw switch, furnish a means of connecting them to the monitor or receiver

Photo shows how six flashlight cells are taped together and connected in series-parallel to give necessary three volts

Troubles That Turn Cars into

Oil Hogs

By **MARTIN BUNN**



Gus held a piece of metal near the end of the exhaust pipe. "See," he said pointing to droplets of water on the metal, "water and unburned gasoline. Every car has it"

JOE CLARK dropped the receiver onto its hook and poked his head through the doorway that led to the Model Garage repair shop.

"Tom Messler was just on the wire, Gus," he called to his gray-haired partner who was half hidden under the hood of a motor. "He's stranded out on the York Road and wants you to come and get him."

"What's his trouble?" Gus Wilson asked as he tugged at the end of a wrench. "Out of gas, I suppose."

"Claims he's out of oil," explained Joe with a shrug. "But I just checked it for him the other day and it was right up to the mark."

"Well, I was about to quit for the day, but I don't suppose we can let a friend spend the night on a lonely road," Gus decided as he rubbed his hands on a wad of waste. "Grab one of those six-gallon cans of oil and I'll meet you at the wrecker."

In less than twenty minutes, the Model Garage tow car, with Gus at the wheel and Joe perched on the seat beside him, pulled up behind a small sedan. Tom Messler's head was framed in the car window as he greeted the two garagemen.

"My crankcase has sprung a leak," he sputtered excitedly. "She's almost dry. First thing I knew, my pressure gage started to drop so I stopped and took a look at the oil and she's less than one-third full."

While Messler talked, Gus peered under the car and then, walking to the rear, followed the general route the car had taken for several hundred feet. When he returned, he was shaking his head.

"Most of your oil is back there on the road," he announced as he slipped his flashlight into his hip pocket. "Been noticing any puddles under your car when it's been parked?"

"Not particularly," Messler replied. "In fact, it was only this morning that I noticed how clean the garage floor was."

"That's funny," mused Gus. "And there's no sign of oil underneath now. The stream ends about three feet back. That means the leak stopped when you stopped your car."

"Do you suppose the drain plug or the crankcase bolts are loose?" put in Messler.

"No such luck," replied Gus. "Chances are it's the rear main bearing. But there's no sense guessing. Let's hoist her up and tow her in. We'll drop you off at your house and you can stop in at the garage tomorrow and I'll go over it with you."

Gus was a little late getting to the garage the next morning and Tom Messler was there waiting for him.

"Well, what's the verdict?" the car owner called as the veteran mechanic entered the repair shop.

"There she is," Gus replied, extending a large thumb in the general direction of his bench. "Soon as I can get into my work duds I'll be with you.

"You can blame two things for that little oil leak that left you stranded last night," Gus explained as he joined Messler beside the open hood of the car. "Bum piston rings and a clogged breather cap on the oil filler pipe. The combination of the two forced the oil through the rear main bearing."

"But what's a breather cap got to do with a bearing?" asked Messler.

"PLENTY," Gus asserted. "In the first place, your piston rings are just worn enough to be leaky. Naturally, any gas that blew by collected in the crankcase. Under ordinary conditions that wouldn't be so bad but in some way your breather cap got clogged with dirt and goo. That closed up your crankcase tighter'n a corked bottle and the gas couldn't escape. Something had to give, so the gas just forced the oil out at the bearing.

"I've seen lots of small oil leaks caused by nothing more than a clogged breather. Even without leaky rings, the up and down motion of the pistons will actually pump up enough pressure to force the oil out if it fails to escape through the breather," he explained to Messler.

"Moral: always see that your breather cap is clean when you check the oil," concluded Messler when Gus had finished. "You know, Gus, I never thought much about my oil until last night when I didn't have any. I never added any between oil changes."

"But that doesn't mean you weren't losing some," put in Gus.

"The oil level stayed pretty much the same," argued Messler.

"That's possible," Gus agreed. "With the blow-by that motor has, enough gasoline probably leaked into the crankcase to make up for any you lost. In every explosion of a cylinder there's a certain portion of the gas that doesn't burn completely. Finally, it's forced by the pistons into the oil. Then, there's the moisture that collects in the cylinders. That ends up in the oil too."

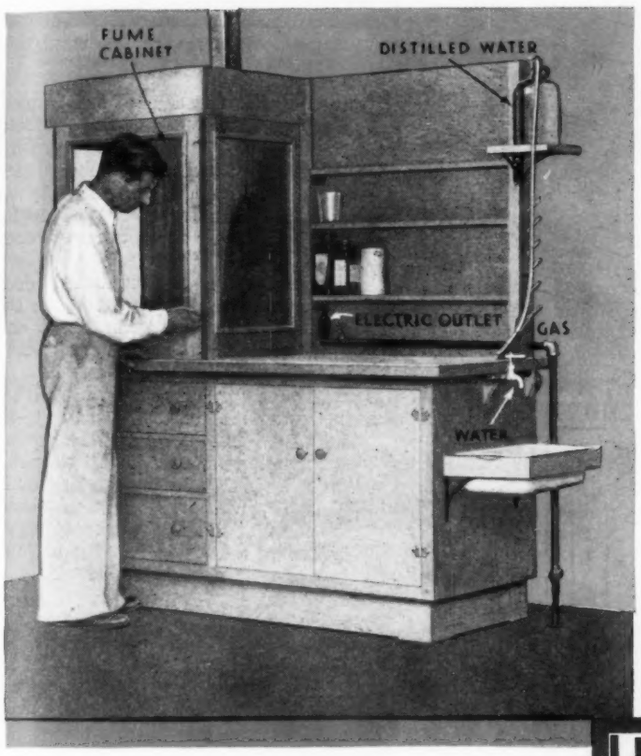
"Moisture?" repeated Messler. "Where does that come from?"

"It's formed when the gas burns," explained Gus. "It's one of the products of combustion. Let's go out in the driveway. Joe has his car parked out there and with a little experimenting I think I can show you what I mean."

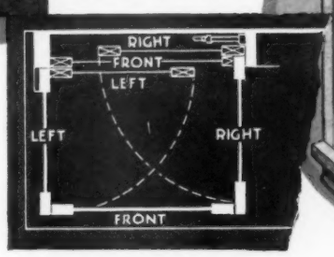
On their way to the car, Gus recruited Joe, who was busy working on some bills in the garage office. As Joe started his car, Gus, sitting on his haunches, held a shiny piece of scrap metal near the end of the exhaust *(Continued on page 115)*

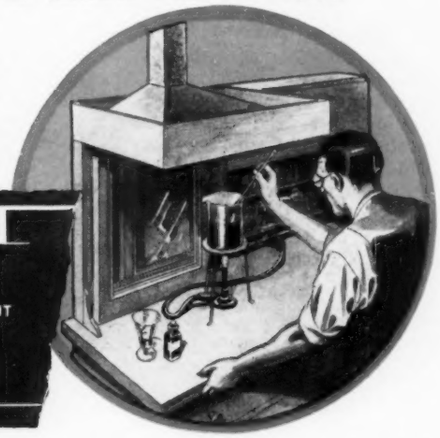
New Chemistry Table

FORMS COMPLETE HOME LABORATORY



Finished bench with fume cabinet ready for use. Note the unpainted pegs for test tubes and glassware underneath the water-bottle shelf





Except when needed for ill-smelling chemicals, the glass sides and door of the fume cabinet are folded back so that the entire top is left clear and open. The two sides swing back on hinges; the door is stored between them

Has Folding Fume Cabinet, Large Working Top, Ample Shelf Room, and Water, Gas, and Electric Connections

By Edwin M. Love

FOR chemical experiments at home, the worktable illustrated above will meet your every need. It is convenient, timesaving, and practical—a complete laboratory in itself. The cost of materials is not high, and the construction has been simplified for those who have had little experience in woodworking and cabinetmaking.

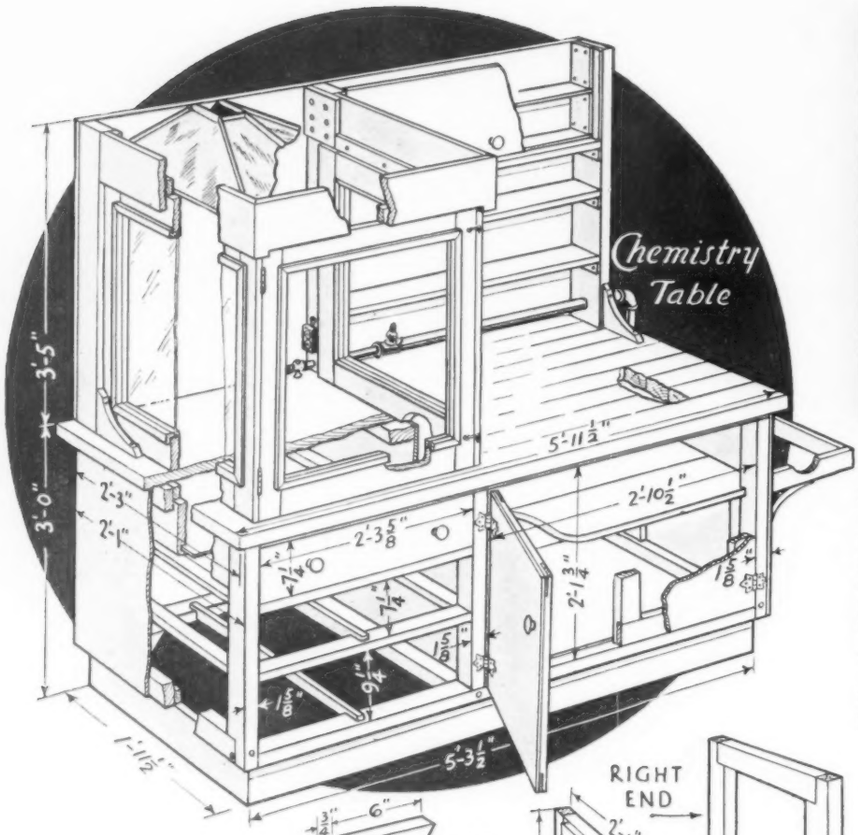
As the table was designed especially for readers of Popular Science Monthly, provisions have been made for any desired individual modifications. For example, if you need only the lower section, the upper may be omitted. If the upper shelves are considered more useful, add the back; and, if preferred, continue the shelves for the full length. If it is convenient to provide a vent, by all means construct the fume cabinet, where ill-smelling brews may be boiled without tainting the air of the workroom. While the drawing shows the bench with the fume cabinet at the left, the construction can be reversed, so that the table will fit any corner of the room.

A gas pipe with two bibs is included. If you happen to own a compressor and power vacuum pump, add pipes and bibs for these in the space below the lower shelf.

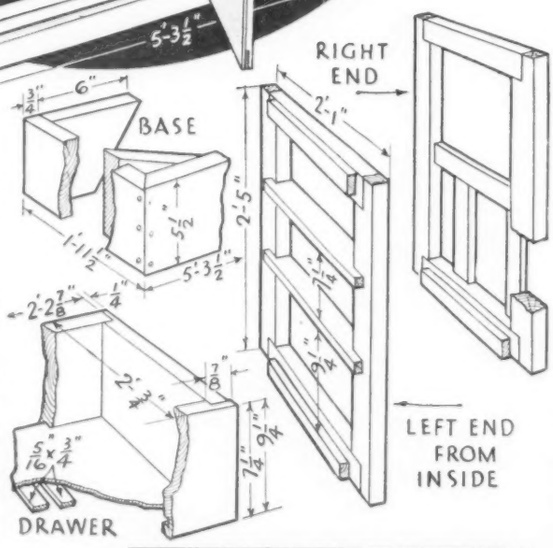
The electric-plug outlets are easy to install, but a water faucet can be used only if the necessary connections can be made with the mains. Likewise, a wash tray is almost out of the question, besides being very expensive. For this reason a rectangular pan held loosely in a frame is shown—a very satisfactory arrangement, since it can be lifted out for emptying. A bottle set on the bracket shelf is a sufficient source of water, and useful for distilled water in case city water is piped to the table.

If possible, get vertical-grained stock for the top, and use casein (waterproof) glue. Hard wood, of course, is best, but pine, fir, or other soft wood is good enough and will last a long time. If straight material planed on all sides is selected, little jointing will have to be done by hand. Put five 5/8-in. dowels in each joint when gluing up the top.

While the top dries, build the frame;



The assembled cabinet, broken away where necessary to show the construction; and details of the end frames, the set-back base, and the drawers



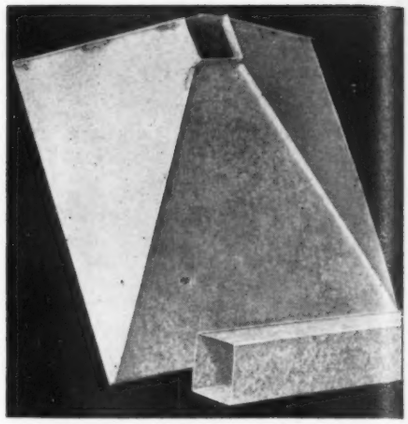
but before cutting any parts, lay out full-sized dimensions on sticks—a long stick for front and back measurements, and shorter ones for end layouts, horizontal and vertical. The use of such sticks forestalls mistakes. Locate and score all marks with the point of a knife and label them with pencil. Use the stock, however, as it happens to come in thickness and width, rather than taking the trouble to conform to the exact figures given in the material list on page 106.

Cut all stock roughly to length and width, straighten when necessary, and mark the working faces and edges. With door and frame stiles, leave the rough length until after assembly, when the projecting "horns" can be trimmed neatly flush.

Much time is saved if one operation is done on all parts requiring it. For instance, when notching drawer slides, end stiles (upright members of the frame) and the like, rip all the tenons with the teeth of the saw splitting the lines and running in the waste, then crosscut them all.

The frame corners are joined with ¼ in. carriage bolts 4 in. long. These are tightened by driving a nail set against the nut corners. When a frame is squared up and braced, if necessary, by tacking on a diagonal strip of wood, glue and screw the cleats and slides in place. When boring bolt holes to attach the long rails, be careful to avoid striking bolts already in

Plane the top level across the grain, then diagonally, and finally lengthwise. In each drawer frame a central guide is used as shown



Hood with standing seams. One edge is bent up and the mating edge folded over

the corners of the assembled end frames.

The frame assembled, nail the drawer rails in place, and square in all directions. Fit the partition against the cupboard side of the center frame, butting it between the rails. Keep the front edge 1 1/16 in. behind the frame front to act as a door stop.

The corners of the cupboard door frames are glued and screwed. When the plywood sheathing has been glued and bradded on, set the doors aside where they can dry in a flat position.

The drawer sides should have 1/16-in. clearance vertically and ⅛-in. sidewise. When attaching the bottom strips, allow about 1/16-in. clearance for the guide, and try the drawer in place before the glue has set. Bevel the edges and ends of the front slightly toward the inside, so that the joint may appear small, yet have plenty of clearance.

To attach the table top, bore three 5/16-in. holes in the back rail, through which to pass 3-in. lag screws. For holding down the front edge of the top, however, make short slots in the end rails, so that the screws can slide when the top swells and shrinks. Notch the top for the back stiles, drill 3/16-in. holes to receive the screws, soap the lag screws, and turn them home. Then smooth the top, joint the front edge, cut the ends and round the corners, and glue ¼-in. strips to the back edge at the ends to make up for the thickness of the plywood back.

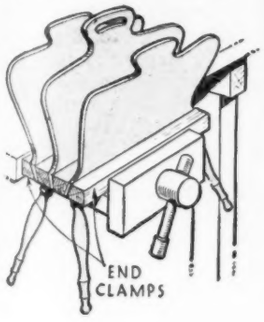
Cover the back, glue and brad the end sheets on, and round the front corners slightly.

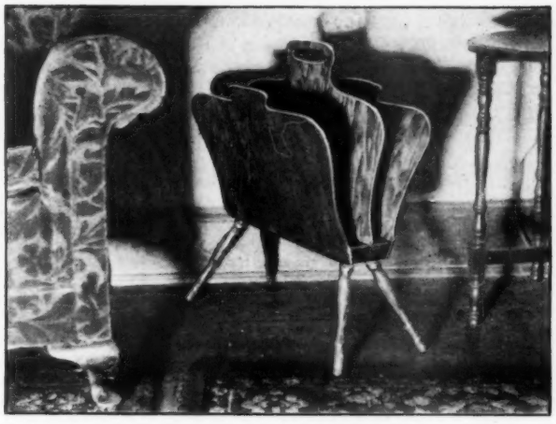
The construction of the back is self-evident. The shelves and hood-apron sides are supported with cleats glued and screwed (or nailed). Notice in the perspective assembly drawing how the front apron, to allow outward opening of the door sash, may be notched above it. The cleat is flush with this notch.

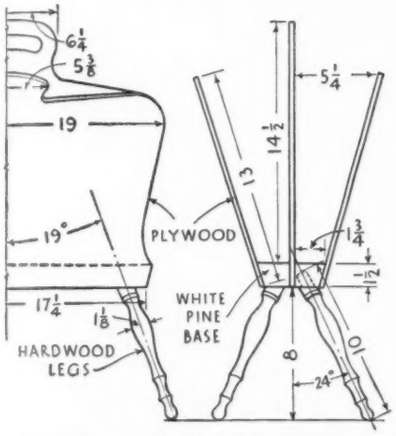
The plywood back extends to the lower ends of the stiles. Install the gas pipe and electrical plug outlets before nailing on the back. Use self-contained outlets and screw them on the center stile, one on each side, flush with the back edge. The pair of wires joining them are inclosed in a short piece of loom passing through a hole bored just above the fixtures. Connect rubber-covered cord to the outlet under the shelf and pass it through a hole in the back. *(Continued on page 106)*

SIMPLY CONSTRUCTED NEWSPAPER RACK

For those who are learning to use small woodworking machines, this rack will give practice in the easiest type of turning and sawing



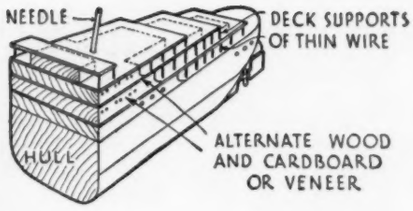




A half side view (with over-all dimensions), an end view, and sketch of clamping method

Because of its unusually simple method of assembly, this newspaper holder can be made by anyone with a home workshop. The drawings show the approximate proportions and dimensions. The legs may be turned from any strong wood; I used a discarded long shovel handle of hickory. The beveled base pieces were made from white pine and the panels from pine plywood. The plywood sides and partition should be cut so that the grain of the two outside plies runs up and down.

Glue is spread on the joints, and the pieces are nailed together with small finishing nails so that they will not slip. In order that the bottom may be clamped in a bench vise, two end pieces are beveled with the same bevel as the bottom pieces and used as shown to press against the joint.—Gerald C. Hennesy.

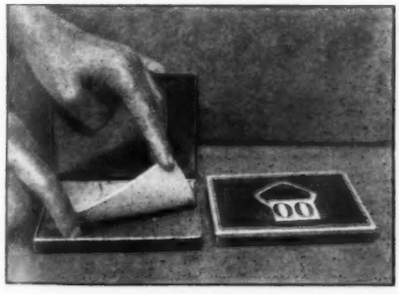


HINTS ON CONSTRUCTING MINIATURE LINERS

When making the decks of miniature liners, such as the *Manhattan* and the *Bremen* models designed by Donald W. Clark, it is best to build them up of alternate layers of wood and either thin cardboard, wood veneer, or stiff, heavy paper, depending upon the scale of the model. Cut the pieces of wood that represent the decks narrower than usual, but cut the pieces of cardboard, veneer, or paper so that they reach right to the edge of the ship and, if the model so indicates, project a short distance over the end of the thicker wooden piece.

It is advisable to paint the edges of the narrower decks black before putting the paper or cardboard pieces on. Details such as portholes and doors may be indicated on the black edges with white paint, while thin pieces of wire may be put in along the edges to represent the deck supports, if desired.

Sewing needles make good masts for miniature ships. Beads are useful; they make good crow's nests, winches, and antenna insulators. Portholes and small lettering can be added with an ordinary pen and black and white inks. Rigging of fine silk thread will add greatly to the ship's appearance, and it is easily put on with transparent cement.—H. J. C. Brodie.



CIGARETTE TINS HOLD SANDPAPER SQUARES

Sandpaper squares are usually kept in an exposed, dusty, unassorted pile in the average home shop. It is much better and more economical to store them in flat tin cigarette boxes of the type shown. These are exactly right for sandpaper and keep it straight, clean, and dry. Numerals can be cut from old calendar sheets and glued to the covers to indicate the grade of paper in each box.—F. W. B.

DENTS IN CELLULOID

When a ping-pong ball has been dented or crushed, it can often be restored by dropping it in boiling water. The same method may also be used with celluloid toys, provided they are not cracked or broken in such a way that the air has leaked out.—Clara Ephrom.

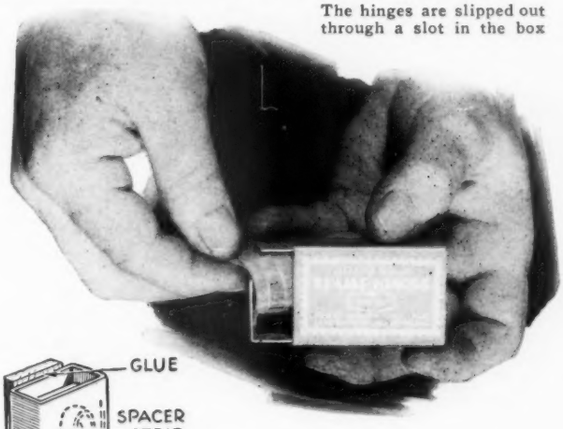
STAMP HINGES SUPPLIED ONE BY ONE

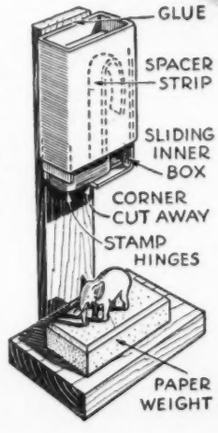
The transparent gummed stamp hinges used for mounting postage stamps in an album are difficult to handle because they stick together and curl once they are dumped out of the box in which they are sold. If the box is of cardboard like the one shown, it is better to keep them in the box and remove them one at a time with the tip of the forefinger through a slot cut with a razor blade in one end of the box.

A convenient method of removing the hinges is to place the box on the edge of a table or desk with the slot overhanging the edge slightly. The ideal way, however, is to make a stand from thin wood, plywood, or pressed wood, as illustrated, and glue the box to it.—W. B. W.

Going to build a ship model? Then turn to our kit list, page 82.

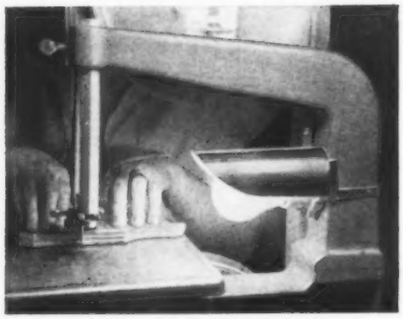
The hinges are slipped out through a slot in the box





STOPPED-UP RIFLES

Many methods of removing rag obstructions from rifle barrels have been used, but the most reliable way, in my experience, is to solder a straightened-out fishhook to a very stiff wire and force this miniature harpoon down the barrel and into the rag. This removes the rag in shreds and occasionally will pull it out whole if both the rag and barrel are well oiled.—J. A. Noviski.



Shaded lamp attached to small band saw so that the cutting line can be followed easily

HOW TO INSTALL LIGHT ON BAND-SAW TABLE

FOR accurate work, a band saw must be well lighted. If you are using a saw without a special lamp provided by the manufacturer, the problem of placing a light so that the line being followed will not be in a shadow can be solved as shown above. A porcelain socket is bolted to a brass strip ½ in. wide and long enough to go around the frame, and ¼-in. holes are drilled in the two ends of the strip. The ends are then turned up, the strip is wrapped around the frame, and a stove bolt is passed through the holes. To prevent the light shining in the operator's eyes, a shade of tin is fastened to the brass strip with solder. The light is controlled through the same switch as the motor that drives the saw.

A similar installation could be made on a drill press or other machine where a light is needed in exactly the right spot. Only a little ingenuity is needed to make such improvements.—DANIEL REYNOLDS.

HAND TRAP GIVES HUNTER PRACTICE

THIS hand trap for clay pigeons should appeal to every hunter because it enables him to make a few practice shots before going afield. It is equally useful for any one who wishes to improve his marksmanship or to practice for a trap-shoot meet.

The headpiece is cut from a 6 by 7 in. piece of ⅛ in. thick pressed wood composition board. The smooth side is kept up for the face. Probably ¼-in. plywood or a piece of stiff sheet metal would serve equally well. The handle is 18½ in. long. I turned it on the lathe, but a section of broomstick would act the purpose. Tape could be wrapped around the grip instead of cutting grooves. A slot is cut in the end of the handle for the headpiece, which is attached with two 1-in. No. 8 screws.

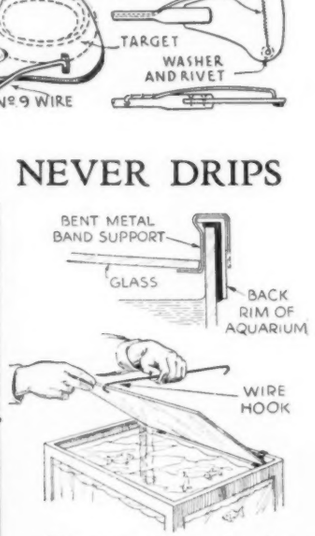
The rubber bottle stopper is attached to the head as shown with a fivepenny nail which passes through a washer on the opposite side of the board and is riveted. The spring on the back of the head holds the clay pigeon in the trap. If the missile flies out too easily, increase the tension of the spring. The spring I used requires about a 5-lb. pull to move the wire to the outer edge of the slot in the headpiece. The dimensions given are correct for the standard clay pigeon, which is 4½ in. in diameter.

A reasonable amount of care must be taken in placing the targets in the trap. Rest one edge against the rubber bottle stopper and turn the target in a clockwise direction until it rests against the end of the wooden handle. If it is desired to make the head a little heavier, this can be done by attaching a piece of metal to the underside.—C. R. MELLEN.

The hand trap with a clay pigeon ready to be thrown. A wire spring holds the missile lightly in place

Left: The assembled trap and sketches showing how its headpiece is constructed

THIS AQUARIUM COVER NEVER DRIPS



The cover is set in place so that the rear edge rests on two hooks attached to the rim as shown in the drawing

WATER in tropical fish aquariums must be kept warm all year round. This means that the water frequently is many degrees warmer than the air in the room. As a result, moisture collects on the underside of the cover in large quantities and when the cover is removed to do any needed work on the tank, the drops of moisture, sometimes amounting to nearly a cupful of water on large covers, invariably run off the edge.

The remedy is to support the rear edge of the glass at a lower level than the front edge so that the drops of moisture will roll off and back into the tank as fast as they form. The accompanying drawing shows how to bend sheet metal hooks so that the rear edge of the glass top is supported inside the tank wall and below the front edge, which rests on the top of the tank frame. The length of the glass, of course, must be reduced so that it will just clear the inside edges of the ends of the tank.

To hold the glass up when necessary, I use a stiff wire bent so that it can be hooked over the front edge of the glass and with the lower end bent to catch in the cement under the angle iron in back of the tank.—W. B. WINTER.

NEAT WASTE BASKET MADE ON JIG SAW

CUT on a jig saw from ⅛-in. plywood, this waste basket is hexagonally shaped, 12 in. wide at the top and tapering to 10 in. at the bottom. Each of the six sides is 6 in. wide at the top and tapers to 5 in. The height is 15 in. An inner basket is made of copper screening as shown in one of the views below, and may be removed for emptying.—THEODORE JEFFRIES.

The basket before it was painted, and, below, a view to show the removable inner container made of copper mesh

MEMBERSHIP CARDS

are issued to twenty-one Home Workshop Clubs

Honorary Member
1934
The National Homeworkshop Guild, Inc.
Official Affiliation Card
December 8, 1933
THIS IS TO CERTIFY THAT Arthur Wakeling
as the date of issuing this card was a member in good standing in the Wood-Ridge Homeworkshop Club of Wood-Ridge NJ. and is entitled to the benefits as an Affiliate of The National Homeworkshop Guild, Inc.
No. 2113
Arthur Wakeling

Every member of a Guild club receives a card similar to that shown above. It is a passport to the new fraternity of home craftsmen and conveys all benefits of the National Homeworkshop Guild, Inc.

President Ryder, right, and Secretary DeLong with a pin map showing distribution of early inquiries in regard to organizing clubs

First Roster of Local Officers Announced by The NATIONAL HOMEWORKSHOP GUILD

Clyde Safford, Rockford Homecraft Club, busy making toys. The Amateurs Homeworkshop Club of Richmond, Va., decided that every member must construct a toy for a child

CARDS in the National Homeworkshop Guild, Inc., have now been issued to the charter members of the first twenty-one home workshop clubs organized under the auspices of the Guild. Nearly 1,000 men in about 400 different communities in the United States and a score of cities and towns in Canada have expressed an interest in forming local clubs. To each of these the Guild has issued full instructions in regard to eligibility, obtaining names of prospective members, where to hold meetings, how to call and conduct the first meeting, how to organize on a permanent basis, and related matters. All this has been accomplished in less than two months after the first announcement of the Guild appeared in POPULAR SCIENCE MONTHLY.

Some of the clubs have already held their second and, in a few cases, their third meetings and have adopted a constitution and by-laws based on the model supplied by Guild headquarters. One club doubled its membership at its second meeting. The Topeka Homeworkshop Club, which organized with twenty-two charter members, has already added nine. The Denver Homeworkshop Club also added nine members at its second regular meeting.

The Amarillo Homeworkshop Club of Amarillo, Texas, which started with fourteen charter members, took a poll and found that its membership included the following occupations: electrical engineer, dentist, science teacher, manual training instructor, laborer, insurance agent, chemical engineer, retired merchant.

The officers of the Topeka Homeworkshop Club are a pharmacist, printer, hardware merchant, and engineer. At one of the meetings of that club a member displayed a collection of more than 100 varieties of wood and explained the characteristics and uses of many of them.

Each club meeting so far reported has been a revelation in the caliber of the men who attended and in their enthusiasm. Much special talent in craftwork has already been discovered among their members. In many cases it became quickly evident that the difficulty would be not so much how to find interesting and informative programs, but how to take advantage of all the knowledge and experience available within the club itself. Some clubs have even suggested meeting once a week instead of every two weeks. In one case it was definitely decided that the business meetings of the club would be held every two weeks, but there would be an informal get-together at one of the members' shops between the regular meetings.

The most surprising thing of all has been for club members to discover that some neighbor whom they have known for years in a casual way was also a home workshop enthusiast. This has happened frequently. It is certain, in fact, that anyone who starts a club will quickly find congenial companions to pursue his hobby with him. For full information, fill out the coupon at the end of this article.

E. Raymond DeLong, secretary of the Guild, has had to answer many questions in regard to the work and scope of the Guild and the organization of local clubs. A few typical questions and his answers follow.

Inquiry: Does the Guild embrace all craftwork? *Answer:* Yes.

Inquiry: May women be enrolled as club members? *Answer:* Yes.

Inquiry: Are there any restrictions as to the number of clubs formed in any one locality? *Answer:* There are no restrictions, but the Guild advises discretion, except in the *(Continued on page 96)*

ADVISORY COUNCIL

Professor Collins P. Bliss
Dean of the College of Engineering, New York University

Dr. Clyde A. Bowman
Dean of the School of Industrial Education, Stout Institute, Menomonie, Wisc.

Harvey Wiley Corbett
Architect, New York City

Dr. Hugh S. Cumming
Surgeon-General, United States Public Health Service

Maj.-Gen. Benj. D. Foulois
Chief of the Air Corps, U. S. Army

Capt. E. Armitage McCann
Founder Ship Model Maker's Club

Dr. Francis G. Pease
Astronomer, Mt. Wilson Observatory

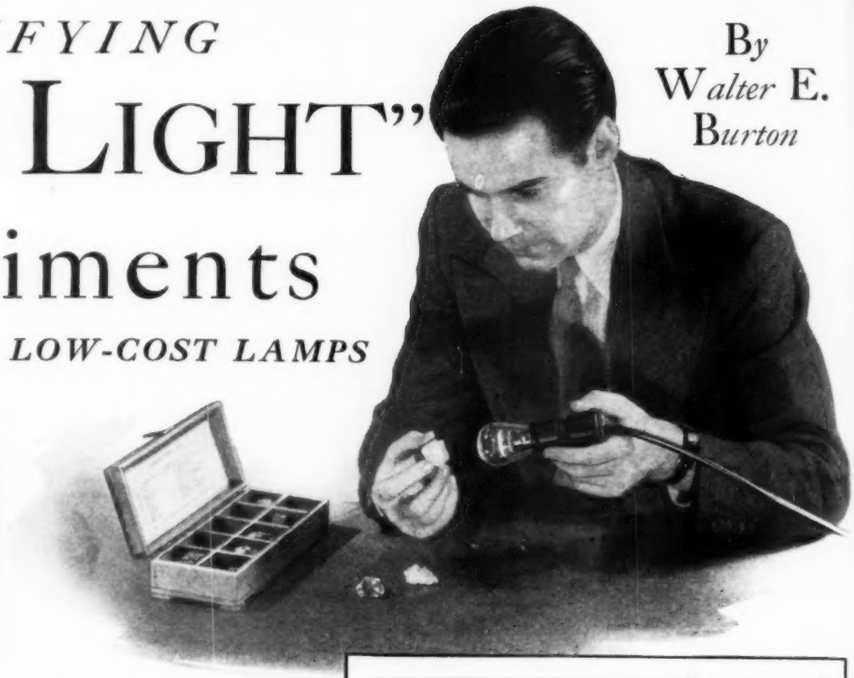
Frank A. Vanderlip
Banker and Publicist, New York

MYSTIFYING "BLACK LIGHT" Experiments

EASILY MADE WITH LOW-COST LAMPS

By *Walter E. Burton*

Cheese, butter, and a Chinese white cross painted on a calendar. These were photographed in white light, then in "black"



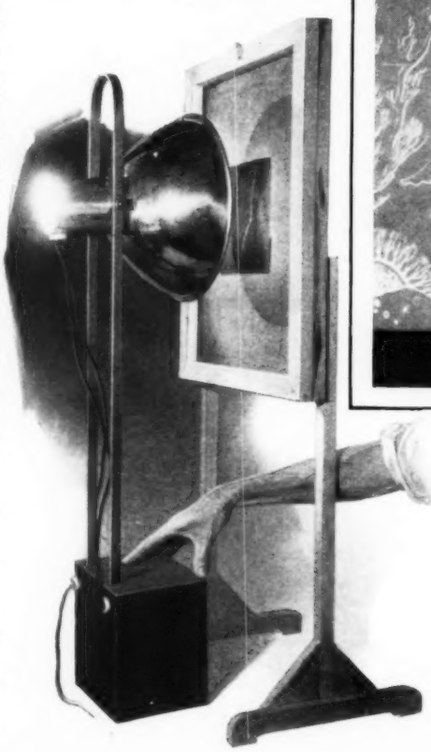
Using a fifty-cent argon glow lamp to examine minerals that give off light of various hues

TURNING a piece of rock into a glowing jewel, converting lubricating oil into liquid light, and discovering whether your friends have any dead teeth are but a few of the mystifying tricks you can perform with "black light" produced by inexpensive equipment. This light is a near-ultraviolet radiation that is invisible to the eye. Its power to make various substances emit light of a visible color causes these magic effects.

Several inexpensive ultraviolet light sources can be used. The ordinary incandescent lamp produces some ultraviolet, but is a comparatively feeble source. A 35-cent photoflood bulb is much better because its filament operates at a high temperature. This lamp burns about two hours on a standard lighting circuit. A still more powerful source is any of the various sun lamps or health lamps, such as those employing the so-called S-1 or S-2 bulbs, or carbon arcs.

The filter suggested by lighting engineers at the Nela Park Laboratories of the General Electric Company for absorbing practically all the invisible rays from a lamp, while permitting the ultraviolet to pass, is a piece of special glass known as "purple ultra-heat-resisting glass." This costs about $3.25 for a piece 6½ in. square. It should be mounted so that it will not be broken by a blow or by strains resulting from clamping, and it must not be placed too near the lamp. Another thing to remember is that the lamp, particularly if one of the photoflood or sun-lamp bulbs, must be well ventilated to prevent damage.

A simple way to fulfill these conditions is to construct a wood frame, say about 24 in. square, and stretch a piece of ordinary screen wire over it. Cut a mask of heavy cardboard or asbestos, making the center opening exactly the size

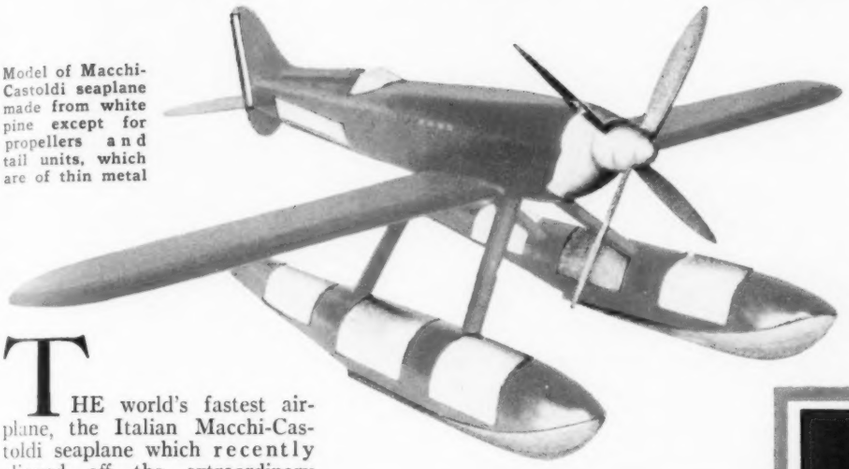


Interior decorations prepared with fluorescent paint as they appear in ordinary light and (the lower view) in ultraviolet illumination. *Left:* Sun lamp with special filter

of the piece of special glass. Lay the glass on the screen wire, place the mask around it, and, if necessary, add a second mask that has an opening slightly smaller than the glass, to keep visible light from escaping around the filter edges. Then place a second piece of screen wire over the glass and masks, and tack the edges to the frame. The glass is thus sandwiched between *(Continued on page 91)*

DONALD W. CLARK tells how to whittle out a model of the

World's Fastest Racing Plane



Model of Macchi-Castoldi seaplane made from white pine except for propellers and tail units, which are of thin metal

THE world's fastest airplane, the Italian Macchi-Castoldi seaplane which recently clipped off the extraordinary speed of 440 miles an hour, is an unusually interesting design for model makers to follow.

Only seventeen units are required, or eighteen if the propeller spinner is cut in two. The parts are nailed together or fastened with glue or household cement.

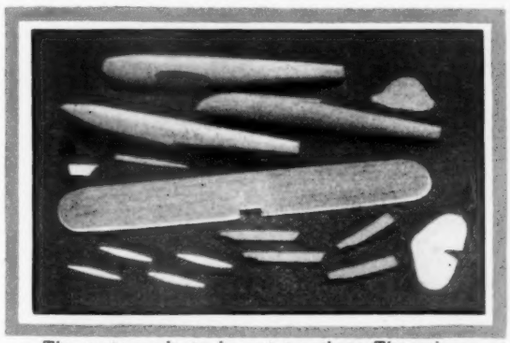
Plane a white pine blank to the size given for the fuselage and shape it with a fine-toothed saw and a sharp knife. Smooth it up with sandpaper. It is easier to cut the tail slots and the wing recess in the block before shaping. Mark where the struts go, and at these points cut in and dig out with a knife point, or use a drill for this.

Make the wing in one piece and fit it accurately to the fuselage, to which it should be nailed or glued. Shape the pontoons from blanks squared to the size given. Smooth them well and make sure the curves are true. Cut in pockets to take the struts, which are set in glue. The struts can be cut from thin wood.

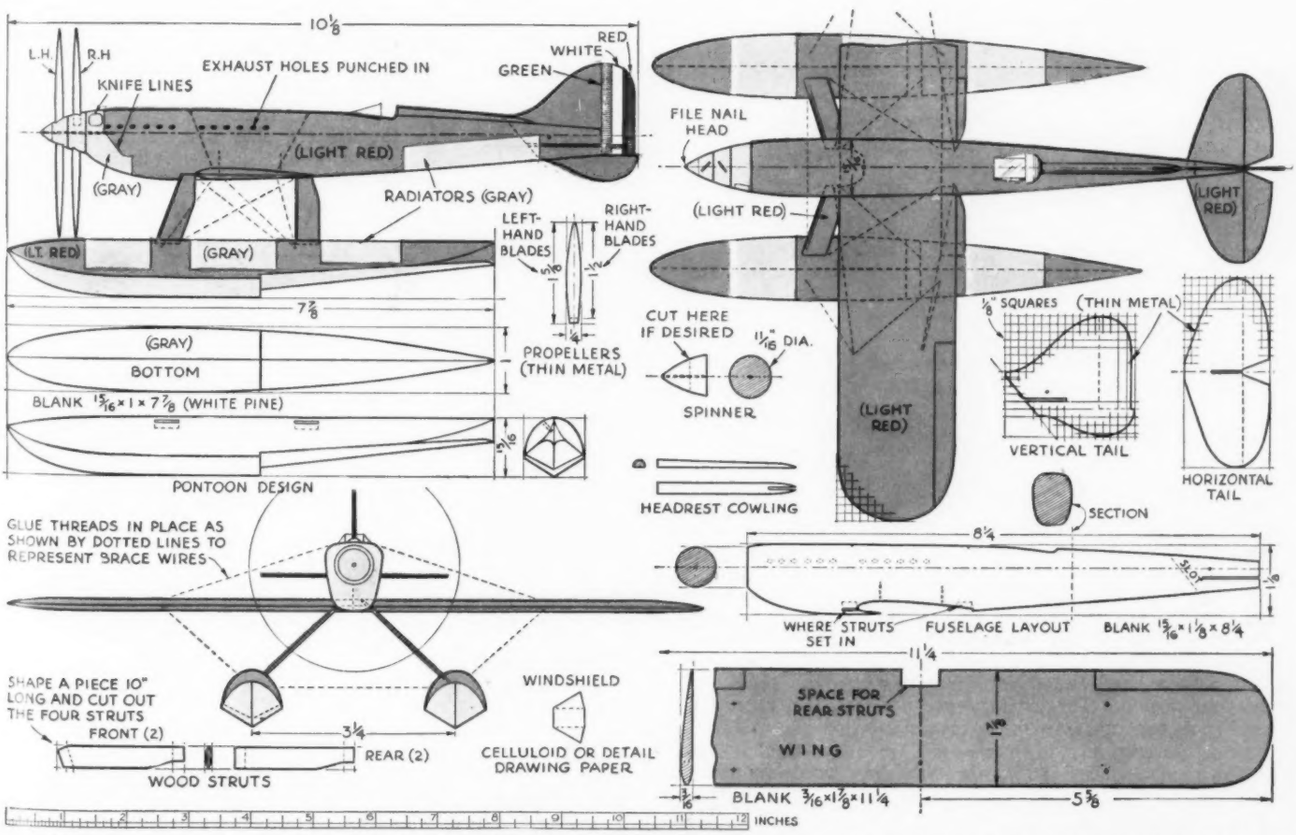
The tail units should be made and attached in the usual manner. The headrest cowling is glued in place. The windshield can be made of celluloid, or yellow (detail) drawing paper will serve.

Cut slots into the spinner to take the propeller blades and glue them in.

Give the entire model a coat of medium gray. Use light red over this, leaving the seven radiators, cockpit, and nose cowling with spinner and propellers, gray. Stripe the rudder as indicated.



The parts ready to be put together. The spinner may be cut in two or left whole and knife-marked



Side, front, and top views of the assembled model and detail drawings of the various parts, with an inch scale for finding any desired dimensions not specifically marked. When built the size suggested, the scale of the model in comparison to the full-size plane is ⅜ in. equals 1 ft.

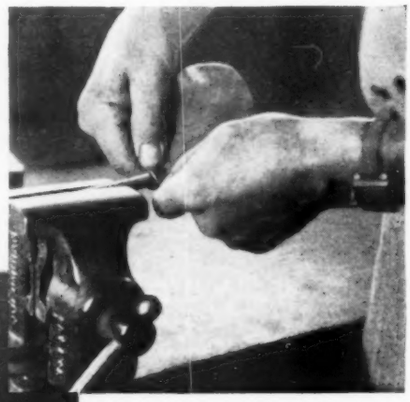
BLUEPRINTS for Popular Science Monthly projects are listed on page 86.

HINTS ON MAKING SALABLE ASH TRAYS

ASH trays are easy to make, are always in demand for gifts and prizes, and it is often possible to sell them at a profit.

If you are a beginner in art-metal work, it will be well to start with lead. Three beaten lead trays are shown below. Each one is made from a disk of 3/32-in. sheet lead 4 in. in diameter, and is hammered into shape with a ball-peen hammer, working from the inside.

The first ash tray in the group at the top of the page is of 18-gage soft sheet copper. It is hammered flat, then bent into shape over a wood block. The second is 22-gage copper. This is not hammered, but is shaped over a ½-in. rod held in the vise as illustrated. The third is brass and the fourth copper. Both are shaped in the same manner as the lead ones.



Forming the flutes of the copper ash tray shown second from left in the group at top of the page. *Left:* Hammering tray from lead. *Below:* Group of three lead trays

The lead trays are left plain. The brass one is merely polished and lacquered. The copper trays are colored in a solution made by dissolving a small piece of liver of sulphur in about a quart of water and immersing the trays until they turn brown. Then they are washed, dried, carefully polished, and lacquered.—DICK HUTCHINSON.

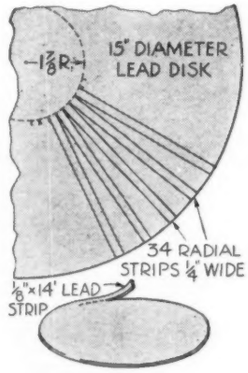
UNIQUE SMOKER'S SET MADE FROM THIN SHEET LEAD

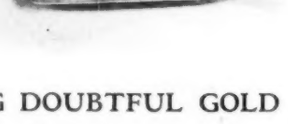
FROM a 1-pt. salad dressing jar and a small sheet of lead 1/16-in. thick it is possible to make a novel and decorative pipe smoking set. Lay out a 15-in. disk of lead and scribe a 2¾- or 3-in. circle in the center. Then lay out and cut 34 radial strips ¼-in. wide as shown. Next prepare a ⅛-in. wide strip by cutting around another disk until you have a piece 14 ft. long.

Bind a piece of friction tape around the shoulder of the jar to prevent slipping. Set the jar in the center of the 15-in. pattern and bend every other strip up. Run the ⅛-in. strip around over these; then bend the others up and the first ones out. Repeat until you have reached and rounded the shoulder. Cut off the underneath strips at this point. Run the ⅛-in. strip around again; then bend the others down over this last weave. The cap, 3¾-in. in diameter, is bent up around the tin jar cap against the edge of the bench.

The pipe tray is 6-in. square with the corners rounded. A rim 1-in. wide is bent up all around, and half of this is bent out and pressed down with a piece of softwood.—T. M. THOMPSON.

The tobacco jar is a glass container over which strips of lead are woven. The pipe tray is a flanged square





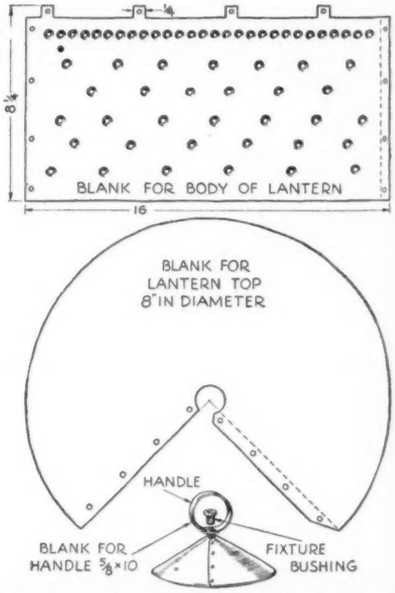
TESTING DOUBTFUL GOLD

IMITATION and spurious gold may be discovered by placing the sample in an air-tight box in which there is a glass or porcelain dish containing a small quantity of iron sulphide. The sulphide is covered with hydrochloric acid, and the box immediately closed. After several hours the sample, if spurious, will be discolored.

OLD COLONIAL LANTERN IMITATED IN COPPER

TO MAKE the body of this replica of an early American lantern, cut a blank 8¼ by 16 in. from 24-gage soft sheet copper, with four lugs on one side as shown. The piece may be merely punched with random holes, or a design may be outlined and punched out. The punching is best done with a sharp-edged nail set on a steel block. When this is completed, roll the piece into a cylinder and rivet or solder the lap joint.

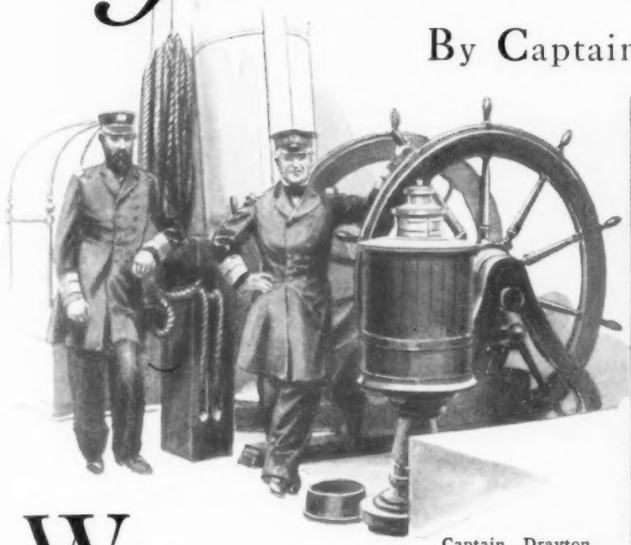
The cap is cut from similar material, bent into shape, and riveted or soldered. Holes are drilled to correspond with those on the lugs, and the two pieces are riveted together with No. 14 brass escutcheon pins. Cut a strip of 16-gage copper ⅝ in. wide by 10 in. long for the handle, bend it into a ring, and rivet the ends together. After drilling a ⅜-in. hole through one side of the ring, attach it to the cap with a ⅜-in. fixture bushing. Leave the lantern in its natural finish and wire it in the usual way.—R. J. H.



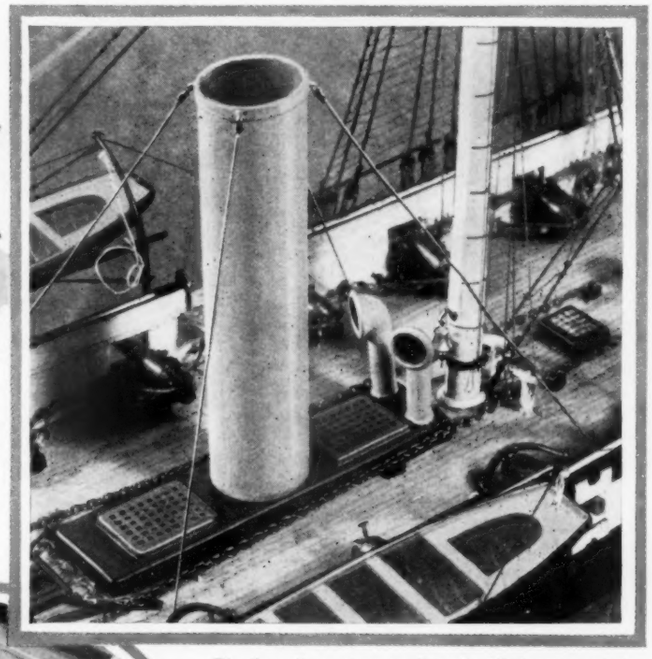
How the blank metal is laid out. The holes may be punched at random or to form a design

Deck Fittings and Guns for Our *HARTFORD Model*

By Captain E. Armitage McCann



Captain Drayton (left) and Admiral Farragut at the wheel of the *Hartford*—drawn from an old photo



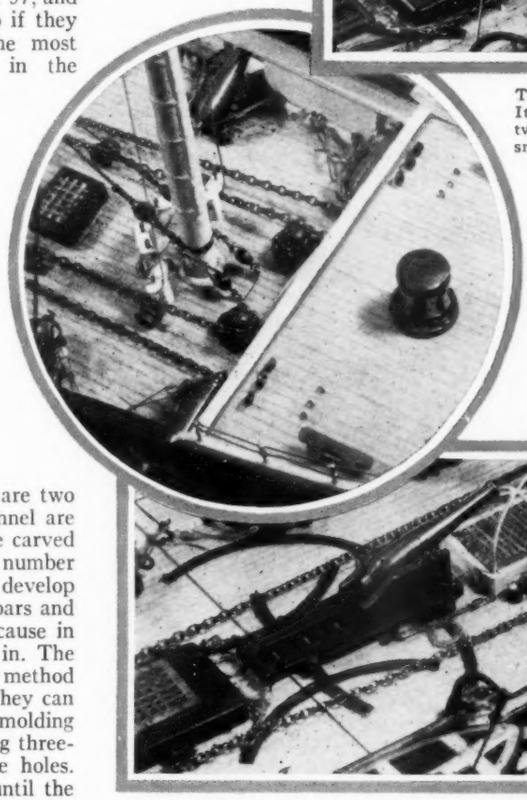
The funnel as set up on Captain McCann's model. It rests on an oblong block, which also carries two grating hatches. Note the ventilators, the small bell on the mainmast, and the anchor chains

WE ARE now ready to make the deck fittings for our model of Farragut's flagship *Hartford*. Those who did not see the two previous installments (P. S. M., Jan. '34, p. 57, and Feb., p. 66) should look them up if they wish to build this model of the most famous steam-and-sail warship in the United States navy.

Suppose we start amidships with the funnel assembly. The funnel is 1 in. in diameter and rakes the same as the mainmast. A piece of brass tube or even a wooden one would do. I made mine from a thin piece of sheet brass, winding and binding it round a wooden form, filing the edges quite thin, and soldering the joint. A ⅛-in. strip is soldered around the top edge. Through this I drilled four holes to which I soldered eyebolts. The funnel will be navy stone color.

The base, or fiddley, is an oblong block ¼ in. thick. On it are two grating hatches, and abaft the funnel are two ventilators. The latter can be carved from wood or cast. There are a number of gratings so it is worth while to develop a good way to make them. The bars and openings cannot be too small, because in the real grating they are only 1½ in. The most tedious but most satisfactory method is to half-lap strips of boxwood. They can be made by cutting a form and molding them in plastic material, or by using three-ply wood, or by punching square holes. This assembly is best laid aside until the model is nearly completed. When put in position, nail down a piece of wood to fit the inside of the funnel and glue the funnel to that.

There are four plain grating hatches of the same height, as shown on the deck plan published last month. I made these from solid blocks into which the gratings are let in. Then there are two companionway hatches—the second from forward and the aftermost on the main deck.



In circle: Looking down past the after end of the forecastle towards the foot of the foremast. *Above:* More deck fittings

I built the sides of these and let the gratings lie in rabbets. Over them are cross wires; these are to spread tarpaulins in wet weather. I let the wires into the edges, then notched where they crossed and there put a drop of solder. These wires and hatch sides will be white; the others black with teak color gratings throughout.

If you want to go to a little extra trouble, instead of putting the gratings on these hatches you can have them open, showing crossed ladders to the berth deck below as in the sketches on page 92.

The *Hartford* hove her anchors in with the old-style quarter-deck capstan. This can be seen at *N* in the deck plan. This can be cut from a piece of wood, with a separate piece for the pawl rack and flattened pin points for the pawls. The top and bottom will be black with dark natural wood for the whelps (cut-out middle portion). A similar but smaller capstan *N2*, ½ in. high, stands on the forecastle head.

We have *(Continued on page 92)*

Triple-Dog Tripod

WHITTLED FROM ONE PIECE

By E. J. *Tangerman*

Whittled novelties made by the author. The tripod at the left supports a bowl 5 in. in diameter

WHITTLING a tripod in one piece, usually in the form of dogs but occasionally like intertwined snakes, is an old, old trick of Oriental or West Indian origin. I have seen several examples brought from Jamaica and other parts of the West Indies, and have heard of such tripods being used to support crystal balls and incense burners. Everyone interested in whittling, should learn to make these.

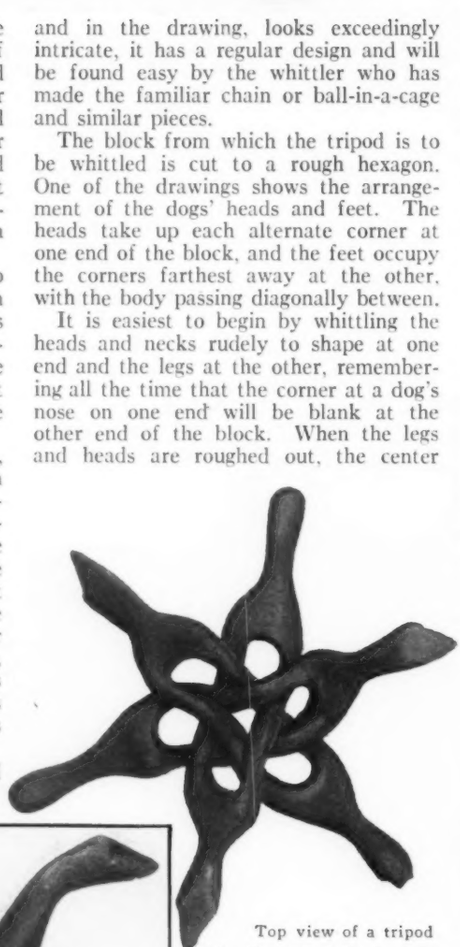
The shapes, of course, do not have to be copied with microscopic accuracy. In fact, no whittler would make two tripods exactly the same. It is true, nevertheless, that all the dog-type tripods I have seen have been almost identical in respect to the head and foot designs, and the serpents are likewise identical.

A hard, tough wood should be chosen, because most of these pieces, when finished, are pressed into service to support trays or ornaments and must therefore bear a little weight. The very nature of the design places the weight across the grain, and there is considerable strain at the ends of the rude link forming the animal's body. I have made a number of these tripods, usually in red mahogany, which has a reasonably dense grain, gives a good appearance when finished, and is tough enough to take the light strains imposed upon the tripod in use.

While the piece, both when finished and in the drawing, looks exceedingly intricate, it has a regular design and will be found easy by the whittler who has made the familiar chain or ball-in-a-cage and similar pieces.

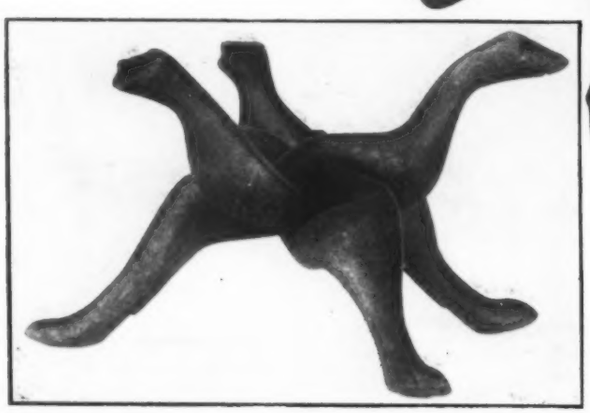
The block from which the tripod is to be whittled is cut to a rough hexagon. One of the drawings shows the arrangement of the dogs' heads and feet. The heads take up each alternate corner at one end of the block, and the feet occupy the corners farthest away at the other, with the body passing diagonally between.

It is easiest to begin by whittling the heads and necks rudely to shape at one end and the legs at the other, remembering all the time that the corner at a dog's nose on one end will be blank at the other end of the block. When the legs and heads are roughed out, the center section may be cut round and the lines of the bodies cut in roughly.



Top view of a tripod

Left: How the tripod opens



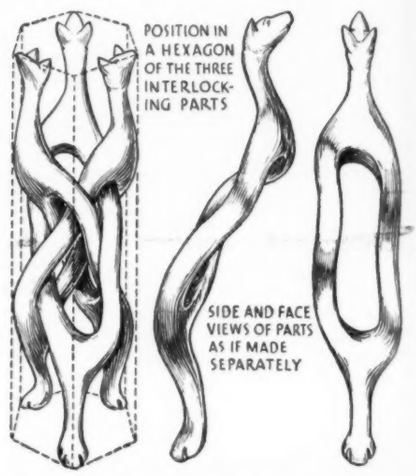
Then begin to work from one head toward the diagonally opposite foot, roughing out the two sides of the body carefully so that too much stock is not cut away. If that should happen, one of the other bodies will be too weak to support its share of the load. When one body has been roughed out, continue from point to point all around the block.

This progressive whittling is continued until the outlines are all smoothed to shape. Probably the wafer blade of a penknife will be required to separate the various bodies. When they are separated, they are smoothed up and thinned to the thickest shape which will allow them to be spread open as shown in the photographs. The heads and feet are then finished, and the whole piece prepared for finishing by sandpapering. I have found a linseed oil dip and waxing best to bring out the natural color.

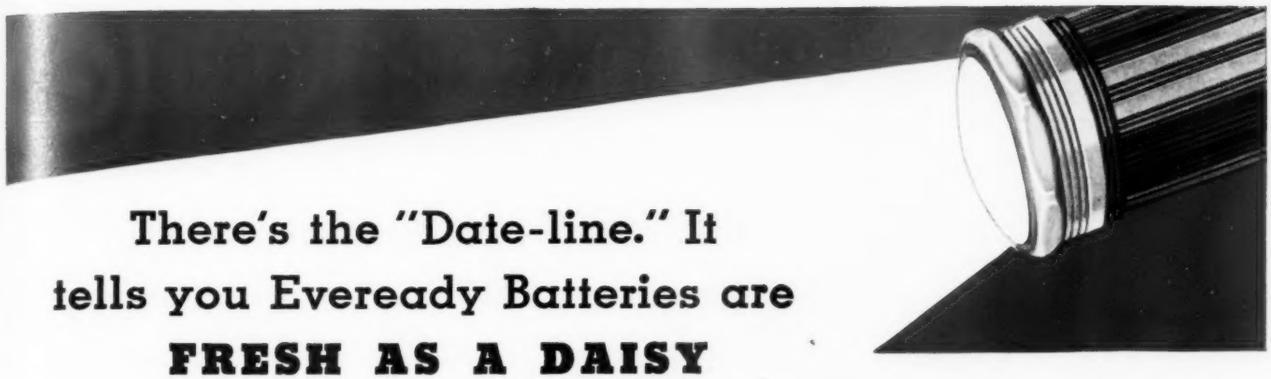
The finished tripod may bear a bowl or crystal, and either may be pinned in securely by passing a screw through the small central triangular opening, which can be seen in the photograph showing the top view. The screw should be set into a small wood block. This is the method used to hold the small ash tray and the 5 in. diameter metal bowl. One tripod—that holding the metal bowl—stands lower than the other because more wood was cut from the dogs' bodies.

Small ash tray resting on a tripod, which is higher than the one holding the metal bowl because less wood was cut from the dogs

For another whittling stunt, see Mr. Tangerman's previous article on wooden fans (P. S. M., Nov. '32, p. 75).



The three dogs are cut in an erect position from a single hexagonal block of hard wood



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YOUR flashlight battery is really "packaged electricity" . . . electricity produced from six powerful chemicals of the type that Science knows as *active*. Naturally battery service is best when these chemical elements are FRESH. Then they have more pep and punch.

Fresh batteries, that's the kind you want . . . and can always get in Evereadys . . . because these batteries sell so fast your dealer always has FRESH Evereadys . . . with a date line on each battery to prove it.

Not only are Evereadys *fresh as a daisy* when you buy them. They're superior . . . in everything that counts. In Evereadys, you buy, for a dime, what forty years of working have taught the world's largest makers of batteries . . . All-armored construction . . . a "power-stabilizer" that keeps the balanced mix of six active light-making elements in hair-trigger alignment . . . and a strong metal top that prevents power from leaking away when the battery isn't in use.

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Millions of unwired radios are powered by Eveready Air Cell "A" Batteries and Layerbilt "B" Batteries. Eveready Dry Cells serve hundreds of users in the home and industry.

THEIR FLASHLIGHT EVEN WORKS UNDER WATER—Of course it seemed impossible that a light *could* be lit under water, said Mabel Holt*, but there it was, our long range focusing flashlight . . . Charley* dived, got the flashlight, and climbing on the bottom of the upturned boat, flashed the light until help came.

8 DAYS ADRIFT! THEN FLASHLIGHT BRINGS HELP—George T. Barnes* (right) showing Captain Henry* of the rescue ship, the flashlight which saved his life on the eighth day of helpless drifting. "Three times I sighted ships in daylight but they couldn't see me," said Barnes . . . "but at night, my flashlight saved me."

SHE—Why Tom Martin! I believe you're afraid of the dark in the attic.
HE—Afraid nothing! I'm playing safe against a twisted ankle on these loose flooring boards up here.

*Not their real names, of course, although these were given in the coast-to-coast newspaper report.

EVEREADY BATTERIES *packaged electricity at its best*

A MATCH-MAKING MOTHER

WHY DORA, WHAT ARE YOU DOING HOME SO EARLY? YOU HAVEN'T QUARRELED WITH THAT NICE MR. M.?
NO OF COURSE NOT, MOTHER. HE SUGGESTED DANCING AFTER THE THEATRE BUT I JUST COULDN'T...
I DON'T HAVE TO TELL YOU WHY MOTHER. YOU KNOW—EVERYONE KNOWS EXCEPT HIM! THATS THE TRAGEDY OF "B.O."
DON'T TAKE IT SO TO HEART, CHILD. WE'LL FIND A WAY TO HELP HIM
NEXT WEEK—Mr. M. comes to dinner
YOU SAY YOU HAVEN'T ENOUGH BUTTER FOR DINNER LET ME GO GET SOME. NEED ANYTHING ELSE?
I'M RATHER LOW ON TOILET SOAP. BUT BE SURE YOU GET LIFEBUOY. NO "B.O." ALLOWED IN THIS FAMILY!

H'M...IF I EXPECT TO BELONG TO THAT FAMILY, I'D BETTER SWITCH TO LIFEBUOY RIGHT NOW. SAY, COULD THAT BE WHAT DORA'S MOTHER MEANT? IS "B.O." THE REASON DORA IS COOL AT TIMES?
NO QUESTION NOW ABOUT MY BEING SAFE FROM OFFENDING! LIFEBUOY GETS YOU EXTRA-CLEAN
"B.O." GONE Dora's in seventh heaven!
YOU AND MR. M. SEEMED VERY HAPPY TONIGHT, DEAR. HAS HE...
YES, YOU DARLING OLD MATCH-MAKER—WE'RE ENGAGED!

HERE'S THE SECRET OF COUNTLESS LOVELY COMPLEXIONS

FRESH, radiant, "Miss America" complexions — how do they come to be? The answer in thousands upon thousands of cases is *Lifebuoy*. This popular toilet soap does wonders for the skin. Its gentle lather *deep-cleanses* pores—brings out natural loveliness.

"B. O." never warns its victims

How easy to offend unknowingly — especially when rooms get overheated! Let's play safe—bathe regularly with Lifebuoy. We can tell by its quickly-vanishing, hygienic scent that Lifebuoy lather purifies and deodorizes pores — stops "B. O." (*body odor*).

Approved by Good Housekeeping Bureau.

NRA WE DO OUR PART

HINTS FOR HARD-TO-SHAVE MEN . . . .

SHAVING SO SOON! BOY, WITH MY TOUGH BEARD AND TENDER SKIN YOU'D BE GLAD TO QUIT SHAVING A WHILE
BET MY BEARD'S TOUGHER THAN YOURS—BUT I WOULDN'T MISS A MORNING SHAVE
WELL, WHAT'S THE SECRET? OUT WITH IT
LIFEBUOY LATHER DOES THE TRICK—IT'S EXTRA-MOIST—SOFTENS TOUGH BEARDS—QUICK. SOOTHES THE SKIN, TRY IT
NO WONDER YOU ENJOY SHAVING WITH THIS LATHER. I NEVER HAD SUCH A SMOOTH, EASY SHAVE. IT'S GREAT!
THAT'S WHAT EVERYBODY SAYS
TRY A TUBE FREE— WRITE LEVER BROTHERS CO. DEPT. A143 CAMBRIDGE, MASS., FOR FREE TRIAL TUBE. IT HOLDS 12 OF THE SMOOTHEST, SLICKEST SHAVES YOU'VE EVER HAD!
LIFEBUOY Shaving Cream
LIFEBUOY Shaving Cream

120 TO 150 SHAVES IN THE BIG RED TUBE—AT YOUR DRUGGIST'S

Gentlemen:

Here's a little tip. If you have a tough beard or tender skin or both—try Lifebuoy Shaving Cream lather. It holds 52% more moisture—soaks the toughest beard soft for the quickest, smoothest, easiest shave a chin ever experienced. And it leaves the skin cool, soothed and refreshed.

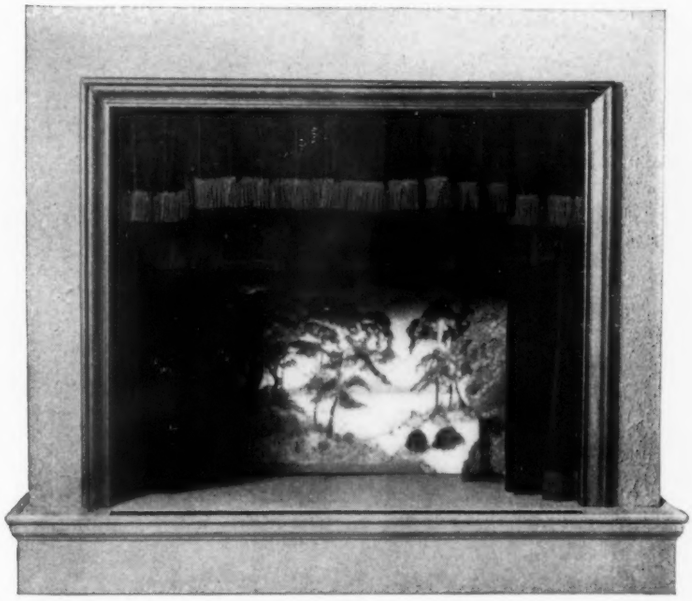
Cordially yours,

Lever Brothers Co.

Curtains *and* Scenery

for dressing up a MINIATURE STAGE

By Benjamin W. Hicks



Miniature stage, built on the scale of 1 inch equals 1 foot, with complete set of curtains. *At left:* Typical wing made of cloth-covered wall board

ANYONE can build the framework for a miniature stage, but it requires some knowledge of actual theatrical practice to dress it up with curtains and scenery in the style of a professional scenewright. The accompanying illustrations show how this may be done.

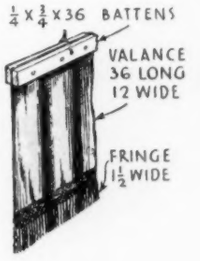
The construction of the stage itself was described last month (P.S.M., Feb. '34, p. 57), and all the dimensions given in this article are for that stage. Everything is to the scale of 1 in. equals 1 ft. The same methods, however, can be used in making curtains and scenery for any miniature stage.

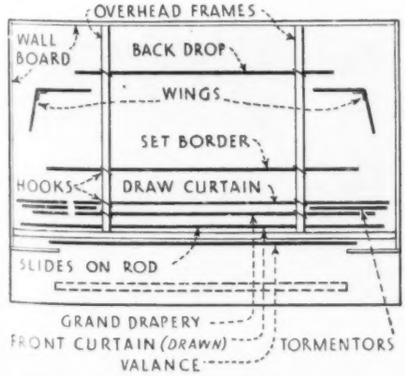
By studying the drawings and illustrations you can learn the relationship of the different parts of the equipment and also where each piece goes when finished. All the hanging pieces are hung from the frame above the stage with wire hooks. By choosing mill samples or ends that are too short for regular use, you can obtain most of the material at a reasonable price from a drapery shop. Velour, velvet, and similar materials are best, for they take light well and are rich in appearance.

The valance is necessary to mask off the top of the stage. It is 36 in. long and 12 in. wide and held by double battens at the top, as shown in one of the drawings. First cut two small battens each ¼ by ¾ by 36 in. Take a piece of lightweight material 14 by 54 in. and cut out the bottom edge as shown in the photograph on page 87. Hem this and finish the bottom edge with a fringe. A suitable fringe about 1½ in. wide may be purchased at a ten-cent store. Mark the center of the material and batten, and pin in pleats about every 3 in. When these are even, fasten them in place with one tack through each pleat. Attach the other batten to hold the material without danger of its tearing out. Drill holes 6 in. from each end and hang the battens with wire hooks from the frame on top of the stage (see photo, page 87).

EASILY STORED
Large as it is, the entire stage may be stored compactly. The scenery is packed away within the base

A small section of the valance showing how cloth is pleated and held between two light battens. The bottom is finished with a fringe





Simplified plan view to show the names and approximate position of curtains and scenery

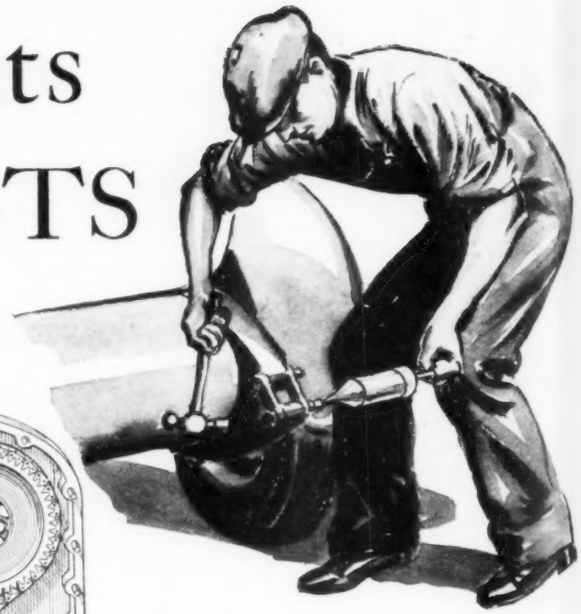
The front curtains are made next. They should be of the same material as the valance. Cut two pieces, each 29 by 24 in. Turn a 1-in. hem on all sides, leaving the bottom hem open so that a small chain or weight may be run through to make the curtain hang straight. When finished, each curtain will be 27 by 22 in. Sew on a fringe to match the valance, and hang. You may use either a traverse rod or a regular curtain rod. These curtains are hung directly behind the valance.

The grand drapery is made in the same manner as the valance except that the bottom edge is straight and is 40 in. long when finished. Leave about 4 in. between the front curtain and the grand drapery when hanging.

Tormentors are used to mask the sides of the stage and should be made of the same material as the grand drapery. As these pieces must stand alone, build a frame 7 by 21 in. and tack the material in place, allowing for pleats. These frames may be made to stand by using small angle irons. *(Continued on page 87)*

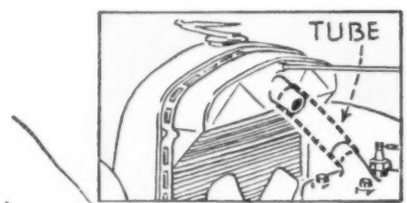
Helpful Hints *for* MOTORISTS

New Ways of Doing Things Described by Our Readers for All Car Workers



When a tight shackle bolt stops the lubricant, jack up the car and tap with a hammer

WHEN lubricating a car equipped with a pressure system, one frequently encounters a tight shackle bolt that has become clogged with old lubricant. Being caked, it forms a tight plug that resists the pressure of the lubricating gun. To loosen such a bearing, simply remove the weight of the car from the spring and tap the bolt with a hammer as the new lubricant is forced in. The free bearing, plus the jarring and the pressure, generally will loosen the old lubricant. In jacking the car up, place the jack under the frame near the spring in question and raise the frame just enough to bring the wheel to the point where the tire is barely touching the ground.—R. McC.

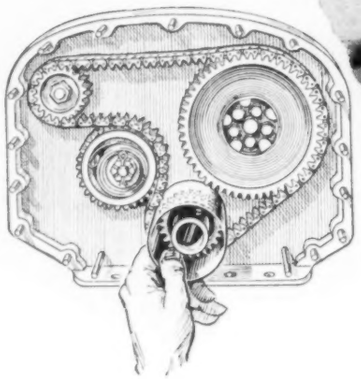


Cutting Rubber Hose

WHEN cutting new sections of radiator hose to the proper length, a neater job will result if you use an ordinary crosscut saw rather than a knife. Simply handle the piece of hose as you would lumber, holding it firmly in a vise or ordinary bench block. Saw slowly and with short strokes, applying just enough pressure to make the saw cut.—G. H. B.

Adjusting Timing Chain

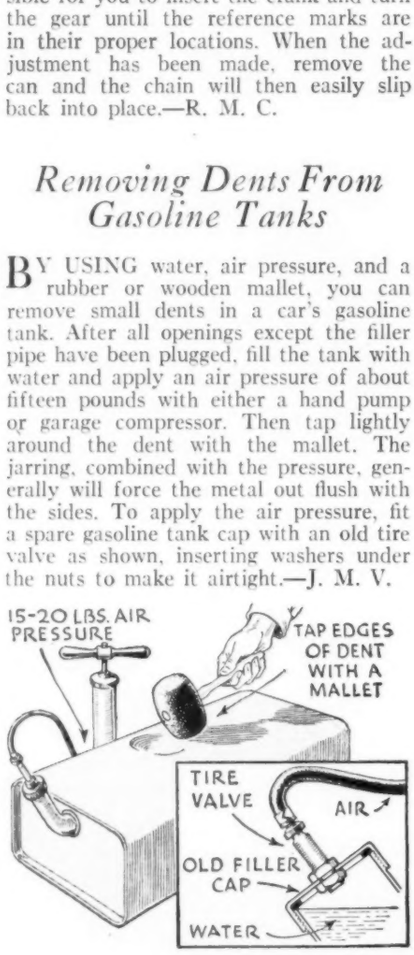
READJUSTING a timing chain that has jumped a tooth oftentimes proves to be a difficult job for the lone mechanic to handle. At best, lifting the chain and turning the crank requires more than two hands. On cars having an automatically adjusted chain, however, the writer has found the following method to be successful: First, cut the top and bottom from an ordinary tin can that is slightly larger

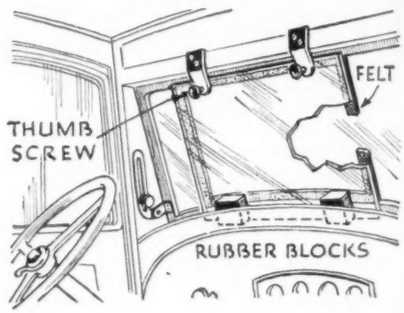


than the crankshaft gear. After the chain has been lifted free, slip the can over the gear. By preventing the gear and chain from meshing, the can will make it possible for you to insert the crank and turn the gear until the reference marks are in their proper locations. When the adjustment has been made, remove the can and the chain will then easily slip back into place.—R. M. C.

Removing Dents From Gasoline Tanks

BY USING water, air pressure, and a rubber or wooden mallet, you can remove small dents in a car's gasoline tank. After all openings except the filler pipe have been plugged, fill the tank with water and apply an air pressure of about fifteen pounds with either a hand pump or garage compressor. Then tap lightly around the dent with the mallet. The jarring, combined with the pressure, generally will force the metal out flush with the sides. To apply the air pressure, fit a spare gasoline tank cap with an old tire valve as shown, inserting washers under the nuts to make it airtight.—J. M. V.





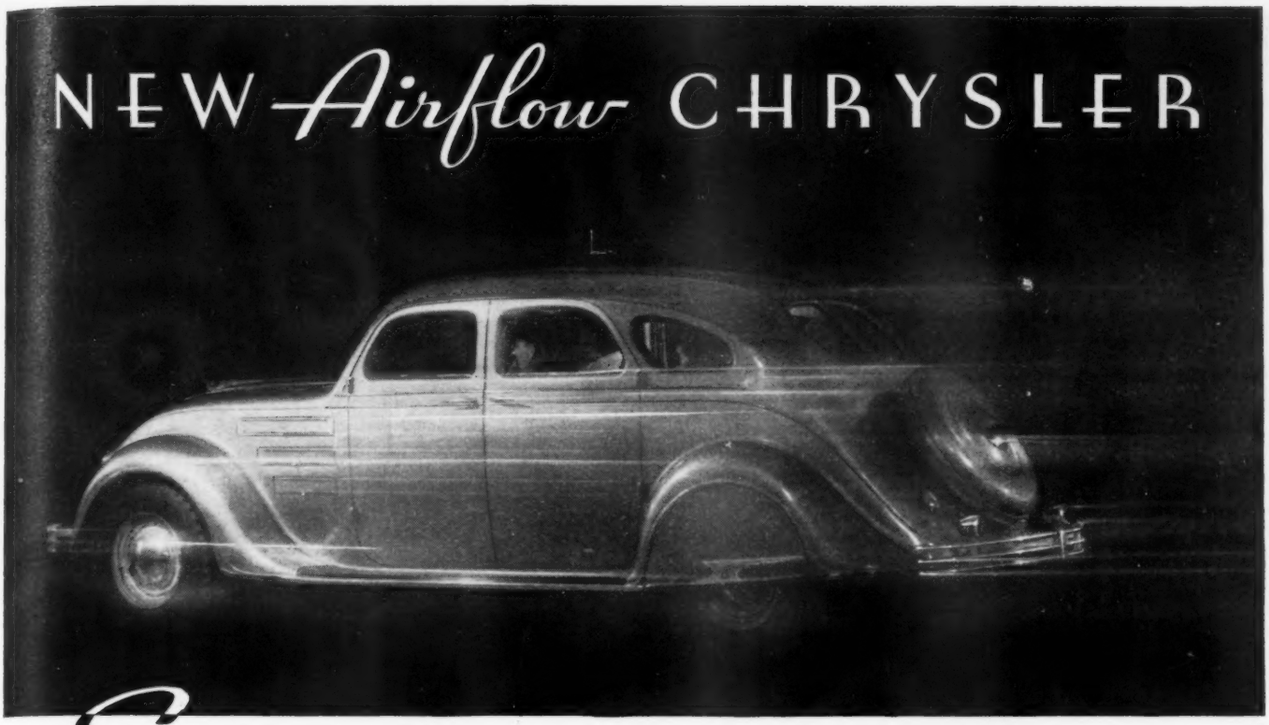
Anti-Steam Windshield

WITH some felt, a section of glass cut from an old windshield, two easily made clamps, and a few blocks of rubber, you can fit your car's windshield with a valuable anti-steam glass. As shown in the illustration, the felt holds the inner glass away from the windshield proper, forming an air pocket that will prevent steam from forming and obscuring the driver's view when it becomes necessary to drive with the windows closed. The two clamps are fastened to the frame just above the windshield, while the two rubber blocks are used as wedges to hold the lower edge of the glass in place. When not needed, the glass can be removed by loosening the thumb screws.—E. E. H.

Running Board Treads

AMATEURS get into difficulty when they attempt to replace running board treads that have worn through, because the new material tends to pucker up in places. This can be overcome by weighing down the new rubber matting with a thick layer of sand until the cement dries. Incidentally, ordinary sodium silicate, more commonly known as water glass, and used in preserving eggs, is an excellent cement for this purpose. It can be purchased in quart cans from any large grocer and will cost less than the same quantity of ordinary rubber cement. —D. J. B.

NEW *Airflow* CHRYSLER



Streamline — with a Reason!

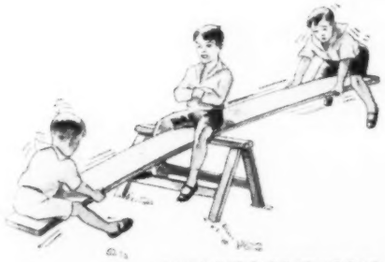
. . . RIDE AT THE CENTER OF BALANCE OF A MOTOR CAR

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

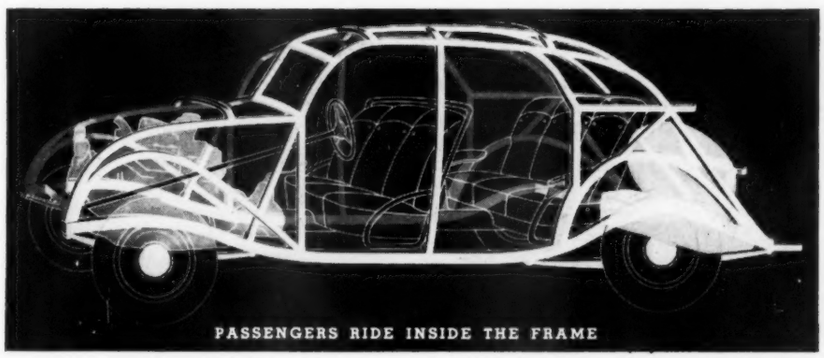
IMAGINE a motor car that actually seems to ignore the road it runs on . . . a car that lets you read or write as you ride at speeds up to 90 and 95 miles an hour!

That's the Floating Ride in the new Airflow* Chrysler . . . and the scientific principles which make it possible are easy to understand.

All the important weights in the car have been redistributed. The engine is *over* the front axle. The rear seat is 20 inches *forward* of the rear axle. Passengers ride in the middle of the car . . . exactly at the center of balance . . . the point of least motion.



★ THE BEST RIDE IS AT THE CENTER OF BALANCE!



PASSENGERS RIDE INSIDE THE FRAME

In addition, the "periodicity"—or rate of spring action—has been greatly slowed down. The motion of the car becomes a long easy glide . . . exactly like riding on a cushion of air.

No motor car in years has introduced so many scientific advancements as the new Airflow Chrysler. It is different in looks . . . different in action . . . different in riding comfort . . . different in its genuine streamlining . . . different in its refreshing new beauty.

See the new Airflow Chrysler and ride in it . . . you'll get one of the thrills of a lifetime.

Four Distinctive 1934 MODELS

CHRYSLER AIRFLOW EIGHT . . . 122 h. p. and 123-in. w. b. Six-passenger Sedan, Brougham and Town Sedan, five-passenger Coupe.

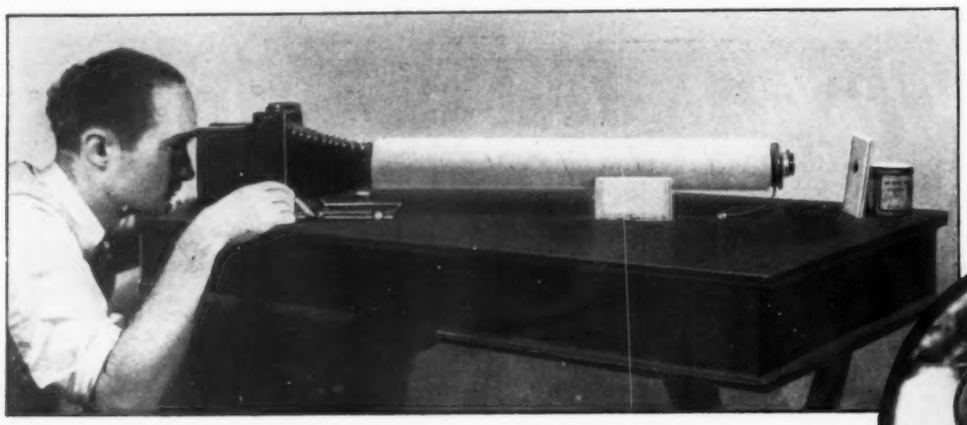
CHRYSLER AIRFLOW IMPERIAL . . . 130 h. p. . . . 128-in. w. b. Six-passenger Sedan and Town Sedan, five-passenger Coupe.

AIRFLOW CUSTOM IMPERIAL . . . 150 h. p. . . . 146-in. w. b. . . . magnificently-styled, individualized body types.

1934 CHRYSLER SIX . . . With independently sprung front wheels . . . for a levelized, cushioned ride . . . 93 h. p., 5 body models on 118-in. w. b. and 2 body models on 121-in. w. b.

FLOATING RIDE BOOKLET FREE — Write for the interesting booklet which describes the romantic development of Floating Ride. Address the Chrysler Sales Corporation, 12206 East Jefferson Avenue, Detroit, Mich.

*NAME COPYRIGHTED 1933—CHRYSLER CORPORATION



By Kenneth Murray

With only your camera and a cardboard tube, you can take

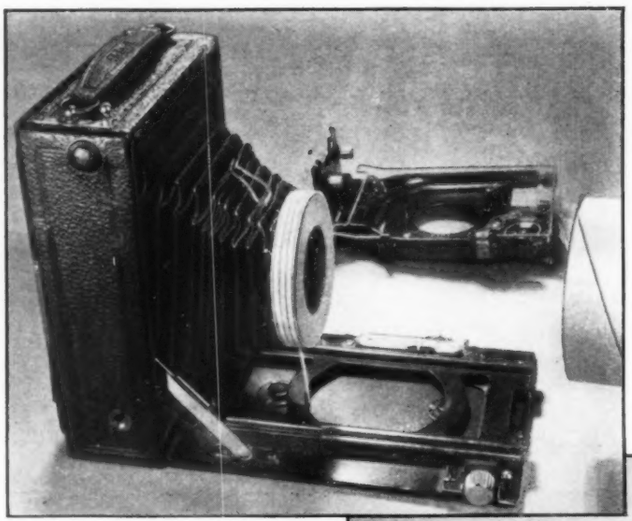
Striking Photomicrographs

EVEN without a microscope, you can make really good photomicrographs of tiny objects and organisms up to forty-six or more diameters. Of course, if you own a microscope, it will aid in selecting subjects suitable for photographing.

The method is much easier and simpler than the standard one of photographing through a microscope. You will need a small hand camera with a good lens and focusing (ground-glass) back, which can perhaps be borrowed if not already available. A larger camera can also be used, but if your camera is of the roll-film type, it must first be fitted up so that a piece of ground glass can be used for focusing at the back and so that a holder for cut film, film packs, or plates can be attached. Then you will need an auxiliary lens of the type sold for copying, which costs less than a dollar and slips over the front of the regular lens; a cardboard mailing tube about 24 in. long and of as large diameter as possible; several small pieces of plywood, some blackboard paint (or a dead-black mixture of shellac and lampblack), and a C-clamp.

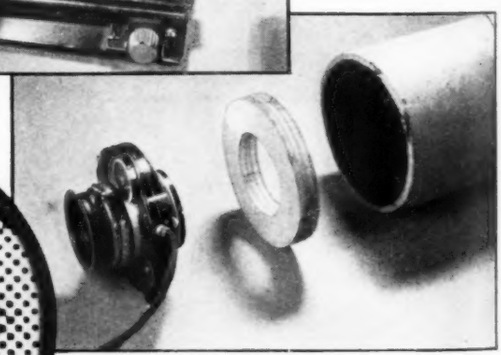
Find the exact inside diameter of the mailing tube and cut two plywood disks to fit snugly. Next unscrew the lens and shutter from the camera. If your camera is of the type having an upright support for the shutter, the support is disengaged from the camera bed and laid aside. On the back of the shutter will be found a lens barrel that projects slightly, and perhaps a threaded bushing. At any rate, make a hole in the exact center of one of the disks to receive the rear barrel or bushing of the shutter. It should be a tight fit.

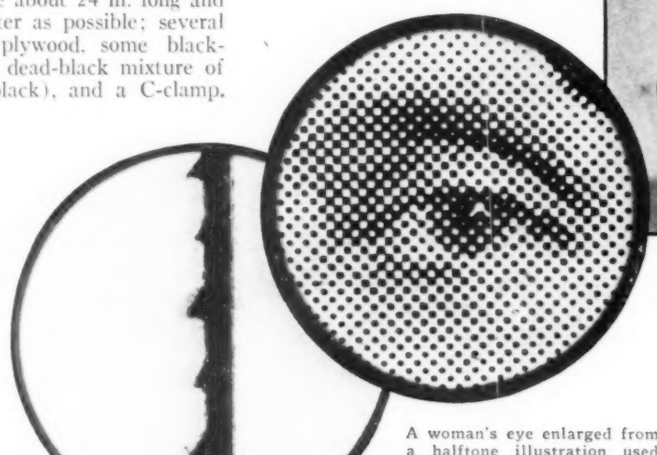
You will find that the mouth of the camera bellows has a metal plate. A hole the same size as the one in the plate is made in the other plywood disk, which is screwed in place as shown in one of the photographs. Mix up the blackboard paint thoroughly *(Continued on page 79)*



After the lens and shutter assembly have been removed from the camera, a plywood disk is screwed to the metal plate at the mouth of the bellows, as shown at the left. The tube fits on this

The lens is mounted in another disk, as shown below, and the disk is inserted in the other end of the tube. The whole set-up appears at the top of the page, except the photoflood lamps used for illumination

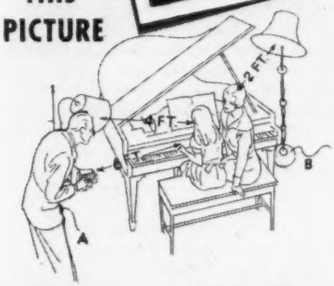




A woman's eye enlarged from a halftone illustration used in this magazine; a new, very fine jig-saw blade; and, in circle near top of the page, the head of an ordinary fly

Snapshots at Night!

HOW TO GET THIS PICTURE



LIGHTING: One Mazda Photoflood in lamp "A"; two Photofloods in lamp "B"; place white sheet over a high-backed chair at subject's left, to reflect light on shadow side. EXPOSURE: 1/25 second at *f*.6.3. FILM: Kodak "SS."

. . . with Eastman's remarkable new "SS" film

FIRST came snapshots in direct sunlight. Then snapshots on dull days and in the shade. Now snapshots . . . indoors . . . at NIGHT!

Just use a camera with an *f*.6.3 (or faster) lens, two or three Mazda Photoflood bulbs that screw into any socket, and Kodak Super Sensitive Panchromatic Film. This new Kodak "SS" Film has three times the speed of ordinary film when used under artificial light.

Hold the camera in your hands as you would in making any outdoor picture. One touch of the button—click—and you've made a snapshot. Indoors . . . at NIGHT!

Interesting Free Folder

Indoor pictures are easy with "SS" Film—the only trick is arranging your lights. Ask your dealer (or write us direct) for the new free folder, "Snapshots at Night." It tells all about it. Eastman Kodak Company, Rochester, New York.

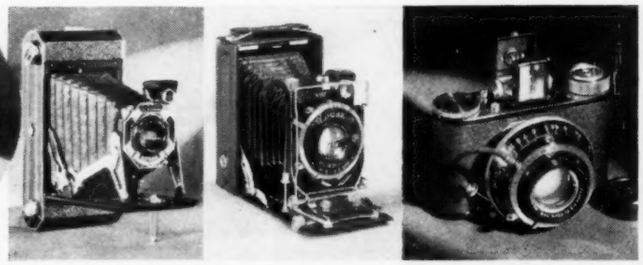
KODAK "SS"—the lightning-fast film, with green lightning flashes on the familiar yellow box.

PHOTOFLOODS (35 cents each)—good for 2 hours of picture-making.

KODAFLECTOR—With stand, reflectors and cord, $5.

FINE CAMERAS . . . Ideal for Night Snapshots

KODAK SIX-20 (below at left), *f*.6.3 lens, 2¼ x 3¼ pictures, $17.50. **KODAK SIX-16**, 2½ x 4¼ pictures, $20. **RECOMAR 18** (center) . . . a versatile camera. Ground glass back, self-timer, double-extension bellows, 1/250 Compur shutter, *f*.4.5 lens—$46. **PUPILLE** (right) . . . miniature camera. Ultra-fast *f*.2 lens, speeds up to 1/300. 16 pictures each loading. With case, range finder, two filters—$90.



IT'S YOURS..

This 48-Page Book and a Generous Sample

BOTH FREE!!

Every handyman, home-craftsman and manual-training student should have this interesting and helpful Gluing Guide. It contains dozens of money-making and money-saving ideas on building, repairing and mending things easily and *permanently.* It tells how you can glue everything to stay glued... in spite of moisture, heat, rough usage or plain neglect.

FREE SAMPLE CASCO Waterproof GLUE

AT NO COST, you will also receive enough CASCO to do several gluing jobs. This is the same super-strength, wonder-working adhesive used in big woodworking and furniture factories. You will be amazed and intrigued to find that CASCO—a clean, non-odorous powder—mixes so quickly in cold water, forming a creamy, easy-spreading glue that makes all jobs *permanent, heat-proof* and *moisture-proof.*

The Big Secret of CASCO'S Great Strength

Unlike ordinary glues and pastes, which harden merely by evaporation, *CASCO sets chemically like concrete.* You only have to glue it once with CASCO.

Your Hardware Dealer carries CASCO in 10c, 25c, 40c and 65c cans. Also 5-lb. and 10-lb. sizes.

TEAR THIS OUT...MAIL TODAY
(Save 2c — stick it on a penny post card)

THE CASEIN MFG. CO. OF AMERICA, INC.
205 East 42nd Street, New York, N. Y.

Please send me my copy of the CASCO Gluing Guide together with your free trial sample.

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P.S.M. 3-34

A LITTLE

Knockabout Table

Designed so that it won't tip over

By PAUL H. NELSON

Because of the design of its base and the way it hugs the arm of an overstuffed chair, this table is much firmer than the average small smoking stand

THIS little table is patterned after one brought to this country from Sweden more than 200 years ago. It may be made of maple or alder, or with a top and bottom of fir plywood, or, if desired, of either veneered or solid walnut or mahogany, the uprights being solid in all cases.

A screw center is used in turning the top. The edge is finished to a 1-in. radius as shown, the top part being slightly rounded off to give a good finish. If no lathe is available to swing the 14½-in. disk, it may be sawed out with a band saw by using a scrap piece of wood to hold a screw upon which the blank for the top is rotated to give it a truly circular form. The edge may then be finished carefully with a router or by hand. If equipment is available and the builder's taste runs in that direction, the outer edge may be cut in scallops to give a pie-crust effect.

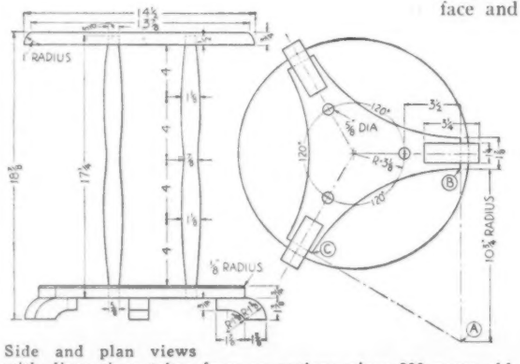
The uprights are next turned from stock 1¼ in. square and about 18 in. long. The marks of the headstock center are cut off when the piece is cut to the finished length of 17¼ in. After these pieces are turned to a uniform diameter of 1⅛ in., the center is reduced to ⅞ in. and the ends to ⅝ in. Smooth curves join the different diameters. The two end portions are cylindrical, one being ½ in. long and the other ¾ in. to fit into ⅝-in. holes bored in the top and bottom pieces.

The bottom piece is next laid out on a piece of ¾-in. stock 12 in. wide. Its form is based upon an equilateral triangle, the concave sides being arcs of circles. The uprights are set in another equilateral triangle of smaller size. The layout is begun by laying out a distance of 1⅞ in. with a distance of 10¾ in. on either side of it along one edge of the stock. With the outer end *A* of the 10¾-in. space as a center, an arc is struck from the end of the 1⅞-in. space *B* until a chord *BC* is also 10¾ in. in length. The other two sides are laid out in a similar manner. The center of the piece is then found by striking arcs from the centers of the flat portions of the edge, and the holes for the uprights are located 3⅛ in. from the center in each of the three corners as shown. The bottom piece may now be sawed out and the top edge rounded off on a ⅛-in. radius.

After the holes for the uprights have been bored with a ⅝-in. bit, the piece may be used as a template to locate the holes in the top of the table. Care should be taken in boring these holes that the spur of the bit does not penetrate the finished upper surface and spoil the top entirely.

The three feet are sawed out of 1¼-in. stock and fastened to the bottom piece with nails or screws. The uprights are glued into the top and bottom, and the table is ready for sanding and finishing.

The type of finish will depend to a certain extent upon the wood used. The original is a hardwood finished in walnut stain. Maple may be finished to match the early American furniture now so popular and protected with a coat of shellac or wax well rubbed in. Paint or lacquer would be suitable for bedroom use.



Side and plan views with dimensions taken from an antique piece 200 years old

YOU CAN TAKE STRIKING PHOTOMICROGRAPHS

(Continued from page 76)

and with it coat the inside of the mailing tube. This may be done easily by holding one end to the light and painting with a brush tied to a long stick. Also be sure to blacken all parts of the wood disks that are exposed on the inside when they are fitted in the ends of the tube.

The outfit is then set up as shown at the top of page 76. A wooden cradle is used to support the mailing tube, and the camera bellows is drawn out most of its length. A good place to assemble the outfit is along the edge of a workbench. Be sure that all parts are steady and without possibility of vibration. Fasten the bed of the camera to the bench with a C-clamp.

THE best mount for the specimens to be photographed is a box about 5 in. square with one side painted dead black, or a miniature easel may be made. In any event the surface must be all black. A light-colored specimen may be mounted directly on this surface; to mount a dark specimen, first fix it to a bit of white cardboard no larger than a ½-in. square, which is, in turn, cemented to the black surface. A dab of water glass is a good cement for this purpose because it dries immediately. If the specimen is prepared on a slide for viewing by transmitted light, cover all but the middle of the slide with black paper and mount it over a hole drilled in the black mounting surface. The light can then be placed in the rear.

The specimen is first focused roughly with the lens wide open by either moving the tube back and forth or placing the mount nearer or farther away. The author uses a photoflood lamp in a reflector at each side and slightly in front of the mount. When the focus is found, close the lens down to F/32 and make the exposure. A rough guide for the latter: light objects, from 5 to 10 seconds; medium, 30 seconds; and dark, such as the head of a fly, 1½ minutes. These are approximately correct for an average camera, lens, and chrome-type film provided the photoflood lights are placed about 15 in. from the subject.

With an outfit of this kind, a magnification of about twelve diameters is obtained. By placing the negative in an enlarger, clear prints showing an enlargement or magnification of forty-six diameters are easy to make; in fact, the negatives may easily be enlarged much more than this without loss of detail. The three sample photomicrographs were all taken with a 23-in. tube and are the actual negative size before further enlarging.

After the reader has seen how easy it is to make photomicrographs in this manner, however, he is advised to use a much longer mailing tube to separate the lens from the camera. Magnification will increase tremendously with the addition of several inches. The exposure must be lengthened accordingly.

If you were one of the hundreds of readers who submitted entries in our November Photo Contest, turn to page 89 for the announcement of the winners.

GLASS CUT ACCURATELY WITH BROKEN FILE

WHEN ordinary glass must be cut to exact measurements, it is difficult to judge distances with an ordinary glass cutter used along a straightedge. A satisfactory cutting point that can be used with absolute accuracy can be made from a three-cornered file. Place the end in the jaws of a vise and snap it off smartly. This will give three cutting points, and when they are worn down it is merely necessary to snap off another short piece.—G. G.

For Snapshots at NIGHT

. . . *with the new* SUPER SPEED FILM

List Price 35c

All you need is a camera with an F/6.3 (or faster) lens (use wide open); some of the new super speed film and a few G-E MAZDA Photoflood lamps in your light sockets. Then you are ready to take snapshots of the family circle, friends, parties, children . . . AT NIGHT!

G-E MAZDA Photoflood lamps are good for two hours of picture-taking . . . good for dozens of pictures.

Get some of these lamps and some of the new film from your druggist or camera dealer and enjoy SNAPSHOTS AT NIGHT! General Electric Company, Nela Park, Cleveland, Ohio.

FOR ACTION PICTURES and shots of babies and pets, use G-E MAZDA Photo*flash* lamps. They operate simply, in light socket or from flashlight batteries. Enable even box cameras to get good indoor pictures. Each lamp gets one picture. Retails for 15 cents.

GENERAL ELECTRIC
MAZDA PHOTOFLOOD LAMPS

EVERY HOME CRAFTSMAN SHOULD FILE HIS OWN SAWS

THE main idea of home craftsmanship is to be able to do things for yourself. And yet, many skillful home tool users do not file their own saws. They put off work until they can get saws sharpened by someone else because they think saw filing is difficult, mysterious work.

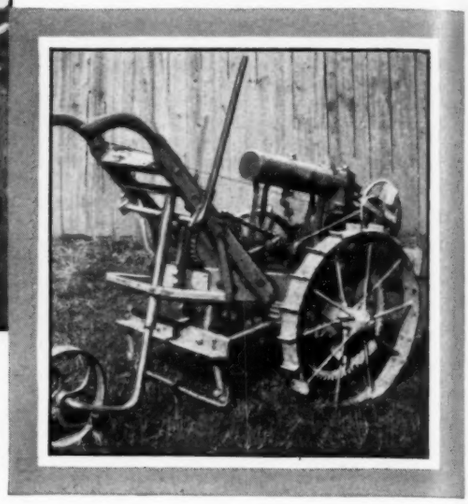
Actually it is not. You can learn to sharpen your own saws quickly and without difficulty with a Nicholson Slim Taper File made especially for sharpening saw teeth, shaped to fit exactly between them, and capable, in your hands, of giving renewed bite to the dullest saw.

Every home craftsman should file his own saws. Go to your hardware dealer and get a Nicholson Slim Taper File. Nicholson File Co., Providence, R.I., U.S.A.

Genuine NICHOLSON FILES

NICHOLSON U.S.A.

A FILE FOR EVERY PURPOSE



Two views of the first-prize tractor with sweep-bar cultivator for dry soil

INGENIOUS READERS WIN PRIZES FOR

Building Garden Tractors

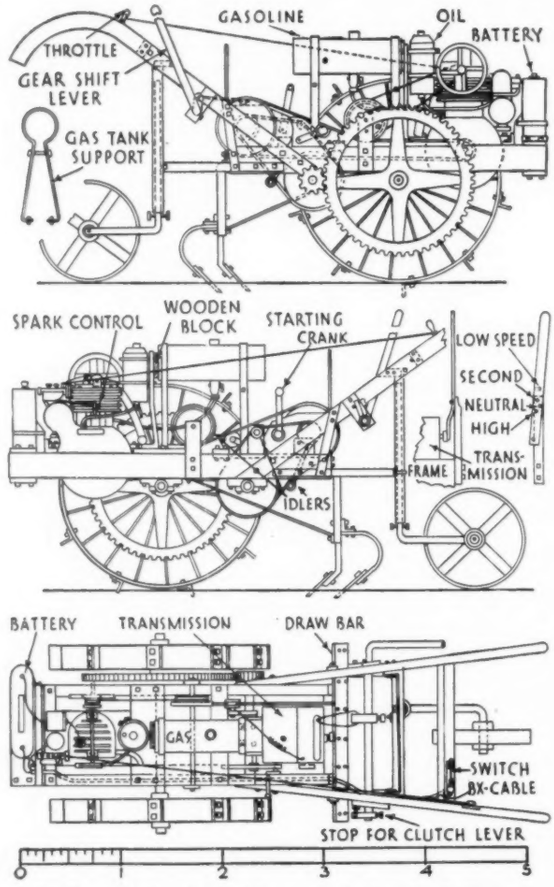
SOME of our readers are saving themselves much back-breaking work in their gardens by using small tractors built from old engines and junked parts. This was made clear by the large number of excellent entries received in our garden tractor contest (P. S. M., Aug. '33, p. 76). Prizes have been awarded as follows:

FIRST PRIZE, $25—William Tanger, Bellefontaine, Ohio.

SECOND PRIZE, $15—J. Wahl, Pottstown, Pa.

THIRD PRIZE, $10—Albert Brown, Chagrin Falls, Ohio.

HONORABLE MENTION—Robert E. Beasley, Camden, Ohio; Donald Beckner, South Lancaster, Mass.; Starling and Herbert Cahill, Danville, Va.; John F. Cote, Amesbury, Mass.; B. J. Cuatt, Battle Creek, Mich.; David H. Depue, Ann Arbor, Mich.; E. M. Hawes, Marietta, Ohio; Arthur E. Hayes, Hillsdale, Okla.; Rudolph Heller, Picayune, Miss.; A. P. Johnson, Ventnor City, N. J.; K. Kacerovsky, Cedar Rapids, Iowa; Malin C. Metzer, Silver Creek, Nebr.; A. W. North, Fond du Lac, Wis.; Carl W. Schick, West Toledo, Ohio; H. A. Troatman, Lewisburg, Pa.



Mr. Tanger's drawings with a scale in feet for finding any dimensions. These, however, will vary with the parts used

The power plant and transmission assembly of Mr. Tanger's tractor were taken from a 1926 model, 3½-H. P., single-cylinder motorcycle of standard make. The tractor has three speeds—1¾, 2½, and 3¾ miles an hour. The wheels have sufficient traction to cultivate a 42-in. strip, but ordinarily a 19- or 26-in. drawbar is used.

A 4-in. breaking plow serves as a furrower, and six 1¼-in. cultivator steels are used for general cultivation. In hot, dry weather, a plain sweep bar sharpened on one edge is substituted for the cultivator steels. By running the bar about 2 in. under the surface, every weed is destroyed, the surface is loosened to save moisture, but the damp soil is not thrown out on top to dry.

The tractor is so well balanced that in cultivating it will go 20 or 30 ft. without

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS.

being touched. It will run four or five hours on 1 gal. of gasoline and 1 pt. of oil. The cost was $23.50, of which $18.65 was for the engine, transmission, chains, sprockets, and rear wheel.

Mr. Tanger's detailed instructions are too long to publish here, but will be sent to any

No work to make this tractor—a motorcycle with two brake drums used as rear wheels

reader who incloses a self-addressed, stamped envelope and 10 cents to cover the cost of printing. Ask for Bulletin No. 19.

Many of the tractors entered in the contest were of a similar general type. Some, however, were much heavier and more powerful, and several even had seats for the operator. Others were lighter and simpler designs. Starling and Herbert Cahill, for example, used an old motorcycle by replacing the rear wheel with two wheels made from old auto brake drums as illustrated.

Another design of extreme simplicity is that shown below, for which E. M. Hawes was given honorable mention. It is made from an ordinary $2.75 hand cultivator and a second-hand washing-machine motor costing $5. In case some readers wish to build a light, simple tractor of this type, Mr. Hawes' instructions are given in Bulletin No. 20, which will be sent to anyone who incloses a self-addressed, stamped envelope and 10 cents to cover the cost.

Mr. Hawes' tractor made from a $2.75 hand cultivator and an old washing-machine motor

© P. Lorillard Co., Inc.

A TOBACCO that won't bite any man's tongue. THAT'S NEWS! But that's only the half of it. The mellowest Kentucky Burley you ever tasted. Matured and aged to the peak of smoking perfection. And a man's sized tin of it for only a dime. Is *that* news?

Of course, Union Leader quality isn't news to the millions now enjoying it. But to the smoker who has never tried it... the first pipeload is like a front page sensation. (Fine for cigarettes, too.)

UNION LEADER

THE GREAT AMERICAN SMOKE

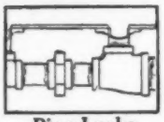
To STOP LEAKS of water, steam, gas or oil from PIPES, BOILERS, TANKS

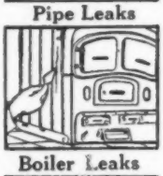
DO THIS with Smooth-On No. 1, and you save at least $1.00 to $10.00 over what a repair man charges for labor alone. With cracked boiler, fire pot or radiator sections, etc., you also avoid the expense for new parts.

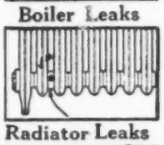
Smooth-On No. 1 judiciously applied at cracks, leaky seams, pipe threads and flanges, seals steam, water, gas, oil, or smoke leaks quickly and permanently.

Householders find hundreds of uses, such as making stripped screws, bolts and nuts hold, tightening loose hooks, locks, hinges, bath room fixtures, handles, casters, mending leaky pots, pans, stove ovens, etc. Excellent for stopping leaks in auto radiators, cracked water jackets, seams in gas tanks, tightening loose hub caps, exhaust pipe and heater connections, lamp and tire braces, etc. A Smooth-On repair holds on any metal and is proof against pressure, heat and vibration.

Smooth-On costs only a few cents per repair and no special tools or skill are required. Merely follow directions in our free book. Expansion of the Smooth-On in metallizing will do the rest.


Pipe Leaks


Boiler Leaks


Radiator Leaks

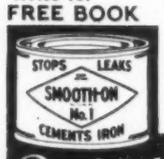
Fire Pot Leaks

Smoke Leaks

Tank Leaks

Furnace Gas Leaks

Write for FREE BOOK



Keep a can of Smooth-On No. 1 handy for emergencies.

FREE BOOKLET

The Smooth-On Repair Booklet, shows dozens of repairs that any home owner can make with big savings, and with perfect results if the simple directions are followed.

Return the coupon for this booklet, and get Smooth-On No. 1 in 7 oz., 1 lb. or 5 lb. can from any hardware store.

Do it with SMOOTH-ON

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574 Communipaw Ave., Jersey City, N. J.
Please send the free Smooth-On Repair Book.

Name .....

Address .....

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3-34

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Construction Kits

will save your time

SHOULD you intend to build our model of Admiral Farragut's flagship *Hartford*, you can save yourself much time by making use of the construction kit marked *L* in the list below. It contains all the raw materials except paints. A model as large and complete as this requires a great variety of materials, many of which are difficult to obtain in small quantities. If you buy them separately, you usually have to take far more than you can use and are charged accordingly. Kit *LL* contains the same materials as *L* but the hull pieces, or "lifts" as they are called, are sawed to shape, ready for gluing.

All kits are accompanied by instructions or blueprints. The list continues on the following page.

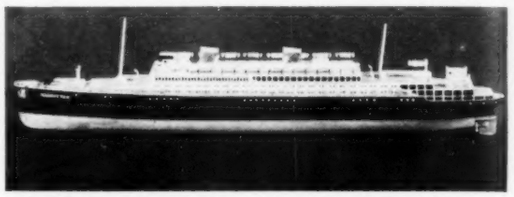
A. Whaling Ship model *Wanderer*. All the raw materials together with Blueprints Nos. 151 to 154 and booklet. The hull is 20½ in. long.....$6.90

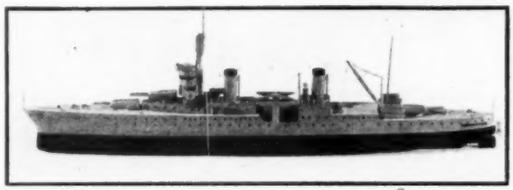
AA. Same with hull lifts sawed .. 7.40

D. Spanish galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet 6.45

DD. Same with hull blocks shaped.. 6.95

E. Battleship model, U.S.S. *Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95

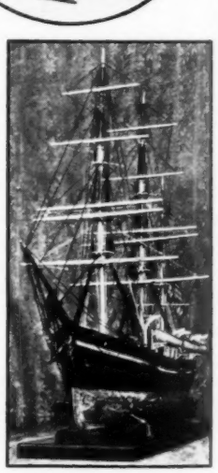

KIT F—Materials for 12-in. model of *Manhattan*

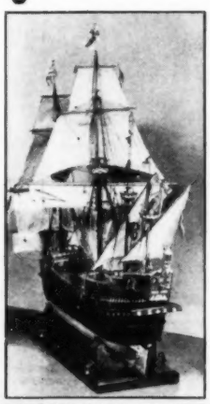

KIT H

KIT D

The historic *Hartford*—KIT L

NO. 6



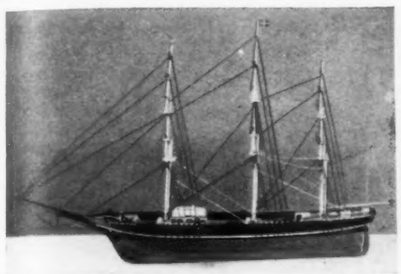

KIT A

Racing yacht made from KIT K

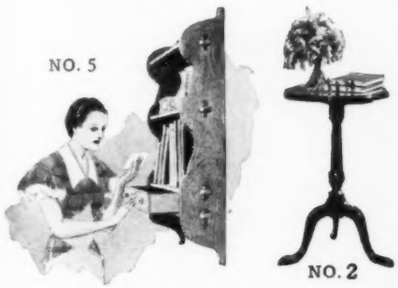
KIT G

NO. 4

KIT E



KIT J—Materials for a miniature clipper ship



EE. Same with hull lifts sawed.... 7.45

F. Liner *Manhattan.* All raw materials (except paints) for a simplified miniature model 12 in. long, and Blueprint No. 204. 1.00

G. Elizabethan galleon *Revenge.* All raw materials (except paints) for a model 25 in. long, and Blueprints Nos. 206 to 209.. 6.75

GG. Same with hull blocks shaped. 7.25

H. Cruiser U. S. S. *Indianapolis.* All raw materials (with enamels) for a simplified 12-in. model, and Blueprint No. 216.. 1.50

J. Clipper ship *Sea Witch.* All raw materials (except paints) for a simplified 13-in. model, with blueprint..... 1.50

K. Jute fiber (tag board) scale model of *Sharpie* racing sloop with 20-in. hull. Can be used as decoration or sailed. Very light and fast. No tools required 2.00

L. Farragut's flagship *Hartford,* a steam-and-sail sloop-of-war. All raw materials (except paints) and special Blueprints Nos. 221 and 222. The hull is 33½ in. long, and the over-all length is 41 in. 7.95

LL. Same with hull lifts sawed ... 8.45

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble, but without finishes..... 5.40

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes.. 5.30

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Address .....

City..... State.....

(Please print name very clearly.)

Note: Prices of all kits except *F, H, J, K* are 50 cents higher west of the Mississippi River because of heavy shipping charges. We prepay the postage on both cash orders and C. O. D. orders, but if you order C. O. D. you will have to pay on delivery the extra charges made by the Post Office, which amount to 28 cents. Kits *F, H, J,* and *K* cannot be sent C. O. D. This offer is made only in the United States.

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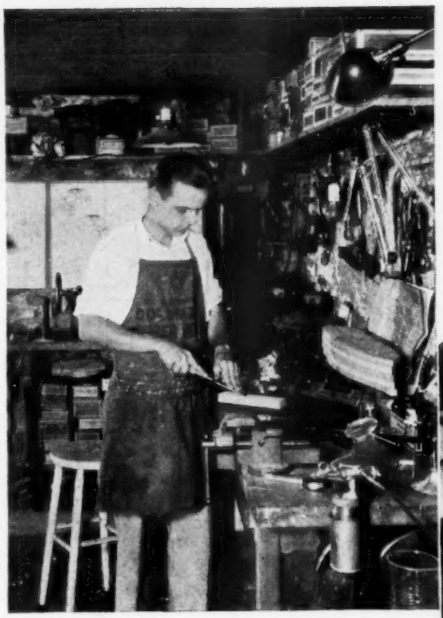
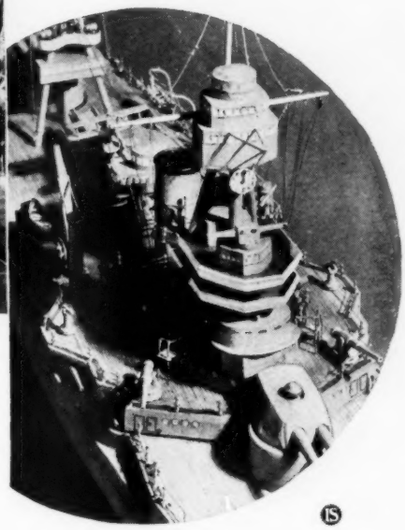
SAYS JACK WICKS
Model Prize Winner





Above is Jack Wicks starting work on a model of the U. S. S. TEXAS. At right, a close-up of this model as it will look when he finishes it.

"THE difference between one prize winner and a thousand runners-up", says nineteen-year-old Jack Wicks, "is not as great as you think".

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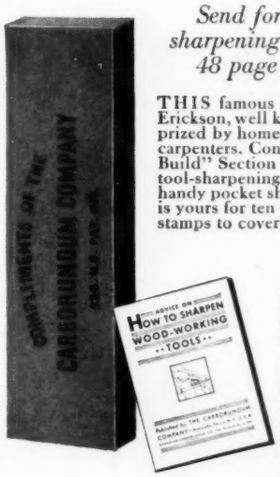

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Glostora

ONE-LEGGED *Armchair Desk*

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THIS one-legged armchair desk is useful and practical, for it enables one to write, draw, study, or play solitaire while sitting in a comfortable upholstered chair instead of bending over a desk or table. The top can be tilted toward the user when desirable. It consists of a frame with a thin plywood top covered with suitable cloth and trimmed with a painted, varnished, or enameled molding.

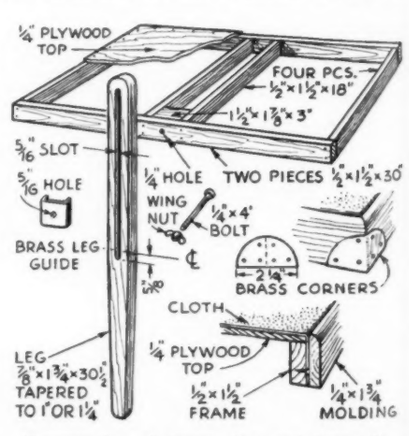
The frame requires two pieces ½ by 1½ by 30 in., four pieces of the same stock 18 in. long, and a block 1½ by 1⅞ by 3 in. A ¼-in. hole is bored through one edge of the frame and through the block to take a 4 by ¼ in. carriage bolt, inserted from the rear and fitted with a wing nut in the front. Cover the frame with ¼-in. plywood, glued and bradded on. Trim the edges flush after drying and slightly round them so the cloth cover will not be cut by them after being stretched. The molding is ¼ in. or 5/16 in. thick and 1¾ in. wide. Two pieces about 31 in. long and two pieces about 21 in. long are required.

The leg is ⅞ by 1¾ by 30½ in., rounded off at the top as shown and tapered from the full width at the center to about 1 or 1¼ in. at the bottom. Cut a 5/16 in. wide slot through it as indicated; this should be started from a point about 5⅛ in. from the top of the leg and should extend to point about ⅝ in. below the center.

Cut two 2¼ in. diameter circles out of thin brass; then cut them in two to form four half circles. Drill six small holes in each half circle as shown to take small brass escutcheon pins ¾ in. long. Polish and bend these pieces along the dotted line. This provides four inexpensive brass corners to be put on over the wood molding. If preferred, you can buy suitable brass corner pieces.

A guide for the leg is now made from a piece of heavy brass about 1/16 in. thick, 1¼ or 1½ in. wide, and 2½ in. long. Drill a 5/16-in. hole in the exact center. Put the plate in the vise and bend down each end so that the piece will fit loosely over the leg. As the leg is 1¾ in. wide and must slide easily in the brass guide, it is well to allow about ⅛-in. play, especially as the paint increases the width of the leg somewhat. Polish the brass with steel wool, scouring powder, or metal polish.

Now select suitable material for the cover, such as the kind ordinarily used for card-table covers. A piece not less than 22 by 32 in. is required, but as the material usually comes 36 in. wide, it is well to get two-thirds of a yard because it is easier to stretch and tack it,



Construction of frame, leg, and brass fittings, and how cloth and molding are added

and afterwards cut off the excess material.

The color of the cloth will determine the color of enamel to use for the trim. If black cloth is used, paint the trim a brilliant red or gold. If the cloth is orchid, use nile green for the trim. If the fabric is light blue, use dark blue or rose trim. First paint the underneath side and edges of the table. The top need not be painted as it is to be covered with the cloth. Also paint the wood molding strips and the leg. After all are hard and dry, stretch the cloth over the top tightly and smoothly, tacking along the sides. Space the tacks, which should be small, about 1 in. apart so the material will stay taut.

If a soft top is desired, a layer of cotton batting or a piece of soft, heavy felt paper can be cut to size and laid on top before the cloth cover is fastened. If the cloth cover is put on directly over the wood top, a hard surface suitable for writing is provided. For a table to be much used for playing solitaire, the softer top is more desirable.

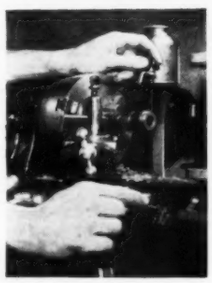
Next carefully measure and cut the four already painted molding strips to fit over the edges and cover the tacks. The corners should be mitered. Nail the molding in place with brass escutcheon pins, but do not put any nails so near corners that they will interfere with the application of the brass corners, which are next nailed on.

Insert a long nail or bradawl from the rear through the hole in the block to locate the center of the hole in the molding trim. Drilling from the front, complete the ¼-in. hole through the molding into the block. Insert the carriage bolt from the rear and drive it home, taking care to avoid splitting or marring the molding. Now place the slot of the leg over the bolt, insert the brass guide piece, and screw on the wing nut.

The leg can be turned so as to lie parallel to the edge of the table, out of way, when the table is not in use.—W. S. GROOM.

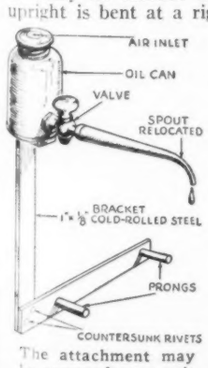
OIL DRIP ON LATHE FOLLOWS UP TOOL

A CUTTING-OIL drip that can be attached instantly to the lathe and will follow the tool in thread cutting may be made of 1 by ⅛ in. cold-rolled steel, a pint size oiler, and a ⅛-in. brass valve.



Adjusting oil drip for shouldering job

The foot of the "L" that forms the bracket is fitted with two prongs or studs spaced to enter the holes provided at the rear of the lathe carriage for holding a taper attachment. These studs are not threaded. The upright of the "L" is of sufficient height to bring the oiler spout above the surface of any piece that will normally be turned. The upper end of this upright is bent at a right angle, and to it is riveted a disk on which the can rests and swivels. This disk should fit just inside the bottom flange of the can. The oil-can spout is removed and relocated as indicated, and the hole left in the filler cap is covered wth a disk in the center of which a small air inlet is provided. When not in use, the attachment is removed.—L. D. RICHARDS.



The attachment may be removed as a unit

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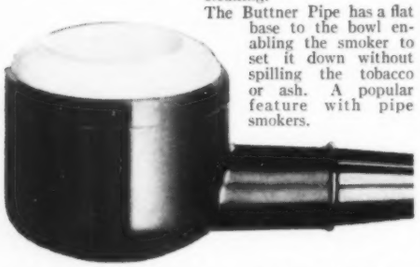

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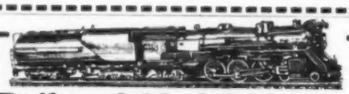

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Pier Cabinet and Corner Shelves, ***77***	.25
Radio Cabinet, Console, ***70-71***	.50
Screens, Modernistic Folding, ***91***	.25
Sewing Cabinets, Two, ***31***	.25
Shelves and Lamp, Modernistic, ***93***	.25
Smoking Cabinet, ***2***	.25
Spanish Mission Armchair, ***195A***	.25
Stand, Low Modernistic, ***100***	.25
Table, Gate-Leg, ***24***	.25
Table, Tavern, ***105***	.25
Table, Tilt-Top, Oak (Top 20 by 24 in.) ***140***	.25
Tea Wagon, ***13***	.25

Radio Sets

Amplifier, Three-Stage, Audio-Frequency, ***42***	.25
Full Electric Headphone Set, ***130***	.25
One Tube (Battery Operated), ***103***	.25
Screen-Grid Set, ***109***	.25
Short-Wave Converter Unit, ***137***	.25
Amateur Short Wave Receiver, ***155***	.25
Amateur Radio Transmitter, ***183-184***	.50
All-Wave Portable Receiver, Battery, ***217-R***	.50

Ship and Coach Models

{Construction kits are available for some of these models. See page 82}

Bark, Scenic Half-Model (13½-in.), ***108***	.25
Battleship—U. S. S. ***Texas*** **(3 ft. Hull),** ***197-198-199-200***	1.00
Bottle, Clipper Ship in, ***121-122***	.50
Clipper, Baltimore (8-in.), ***92***	.25
Clipper Ship (20½-in. Hull), ***51-52-53-R***	1.00
Clipper, Simplified (9½-in. Hull), ***219***	.25
Constitution **(21-in. Hull),** ***57-58-59-R***	1.00
Covered Wagon (23½-in.), ***118-119-120-R***	1.00
Cruiser ***Indianapolis*** **(12 in. long),** ***216***	.25
Destroyer—U. S. S. ***Preston*** **(31½-in. Hull),** ***125-126-127-R***	1.00
Galleon ***Revenge*** **(25-in.),** ***206-207-208-209***	1.00
Galleon, Spanish Treasure (24-in.), ***46-47***	.50
Hartford**, Farragut's Flagship (33½-in. Hull), special prints** ***221-222***	1.25
Mayflower **(17½-in. Hull),** ***83-84-85-R***	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., ***202-R***	.50
Motorboat, 29-in. Cruiser, ***63-64-R***	.75
Motorboat, Working Model (20-in.), ***196***	.25
Liner—*Bremen* **(20 in. long),** ***158A***	.50
Liner—*Manhattan* **(12 in. long),** ***204***	.25
Pirate Galley or Felucca (20-in.), ***44-45-R***	.75
Roman Galley (19-in.), ***138-139-R***	.75
Sails—Square and Fore-and-Aft for Whaler ***Wanderer*** **or any Model,** ***185-186***	.50
Santa Maria **(18-in. Hull),** ***74-75-76-R***	1.00
Schooner — ***Bluenose*** **(17½-in.),** ***110-111-112-R***	1.00
Sedan Chair, Queen's (12-in.), ***123-124***	.50
Stagecoach (20½-in.), ***115-116-117-R***	1.00
Stagecoach (Cody), with Horses (Coach Body 13 in. Long), ***144-145-146-R***	1.00
Steamboat, Mississippi (19½-in.), ***94-95-96-R***	1.00
Viking Ship (20½-in.), ***61-62-R***	.75
Weather Vane, Ship Model (30-in.), ***66***	.25
Whaler—*Wanderer* **(20½-in.),** ***151 to 154***	1.00
Yacht, ***Sea Scout*****, 42-in. Racing,** ***106-107-R***	.75
Yacht, 20-in. Racing, ***48-R***	.50

Toys

Airplane Cockpit with Controls, ***114***	.25
Birds and Animals, Jig sawed, ***56***	.25
Doll's House, Colonial, ***72***	.25
Drill Press, Lathe, Saw, etc., ***113***	.25
Dump Truck, Fire Engine, etc., ***101***	.25

Miscellaneous

Bird-House Patterns (Full Size), ***P-1-2-3***	.25
Log Cabin (Three Rooms), ***134-R***	.50
Microscope Kit, Portable, for Holding All Equipment, ***220***	.25
Perpetual Star Chart, ***214***	.25
Tool Cabinet, Bench Hook, etc., ***30***	.25
Workbench, ***15***	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....

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I am enclosing.....dollars.....cents.

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Note: Please print your name and address very clearly. If you do not wish to cut this page, order on a separate sheet.

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A GRACEFUL sweep of cedar . . . tight-planked . . . strong ribbed . . . covered with seamless, water-tight canvas. The effortless stroke-stroke-stroke of a paddle unfolds the glory of all outdoors. Get an Old Town Canoe.

1934 Old Towns cost as little as $68. Send for a free catalog, showing models and prices. Also sailing, sponson, square-stern canoes and outboard boats. Including big, fast seaworthy models for family use. Rowboats. Dinghies. Write today. Old Town Canoe Co., 593 Fourth Street, Old Town, Maine.

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SOLDERING IRON AND BLOW TORCH IN ONE

Pays for itself in one job! Needs no pump or pressure system—no stove—no charcoal—no separate blow torch. Burns an hour at less than ¼ cent for gasoline.

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Make Beautiful Furniture at a fraction of the Store Cost

Big 72 Page Catalog F—full of Bargains

Home woodworking book—color illustrations—inlay bandings—scroll patterns—blue prints—various wood grains, crotch, butt, quartered, burl, fiddleback, plain sawn, etc.—tells how to finish woods natural—foreign woods—jig saw puzzles. Articles you can make—desks, tables, book shelves, picture frames, etc. Send for it today—only 10c, or FREE with $1.00 or more order.

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L-106

Craftsman Wood Service Company
We Ship All Over The World
2729 Mary Street Chicago, Ill.

LIKE TO SHOOT?

Do you enjoy hunting or target-shooting, with rifles, revolvers or shotguns? If so, six cents in stamps will bring you full details about the many unusual benefits of membership in the National Rifle Association—including a sample copy of THE AMERICAN RIFLEMAN, the one publication devoted *exclusively* to guns.

National Rifle Association,
855 Barr Bldg., Washington, D. C.

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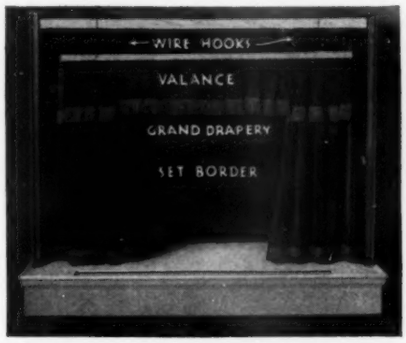
CURTAINS AND SCENERY FOR MINIATURE STAGE

(Continued from page 73)



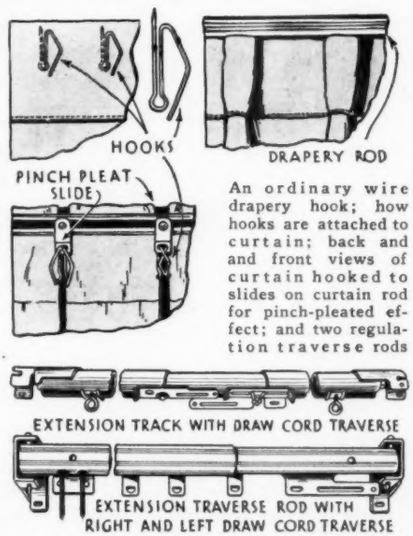
Stage with its front taken off to show how the curtains are hung by means of wire hooks

It will take two pieces of fabric each 15 by 22 in. to cover the frames, one for each side of the stage. They stand between the grand drapery and the main draw curtain.

The main draw curtain, like the front curtain, is made of rayon or silk and must have a traverse rod for ease in opening and closing. The drawings give details for hanging curtains on traverse rods. This curtain is hung behind the grand drapery, leaving enough room for the tormentors to stand between.

Wood borders or set borders are made of window shade material or sign cloth and are hung from wood battens in the same manner as the valance. The bottom edge of the wood border may be cut out to represent leaves and branches of trees above the stage. These are painted with show-card colors to match the wood drops.

The wood drops are made of the same material as the wood border and are 18 by 30 in. They have double wood battens at both top and bottom. Paint any scene desired with show-card colors, taking care not to go into too much detail.


HOOKS
DRAPERY ROD
PINCH PLEAT SLIDE
EXTENSION TRACK WITH DRAW CORD TRAVERSE
EXTENSION TRAVERSE ROD WITH RIGHT AND LEFT DRAW CORD TRAVERSE

An ordinary wire drapery hook; how hooks are attached to curtain; back and and front views of curtain hooked to slides on curtain rod for pinch-pleated effect; and two regulation traverse rods

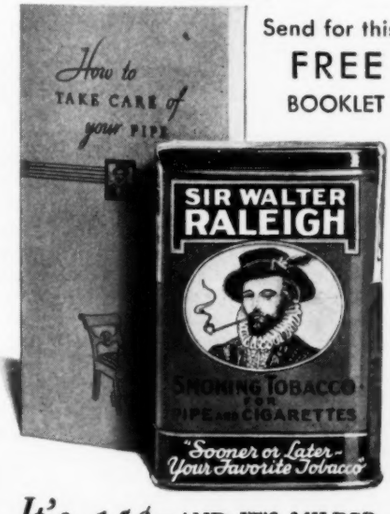
Wings are used on each side of the stage to mask the sides. They should match the back drop and borders. Use two pieces of wall board or pressed wood composition board cut 6 by 18 in. for each set of wings. A strip of heavy cloth tape 2 in. wide and 18 in. long is glued on to make a hinge as shown. Cover the entire surface with shade material or sign cloth, and apply a size of thin glue. Paint to match other pieces of the same setting.

Many of the new *(Continued on page 89)*

"I CAN USE A GOOD STOKER"

DEVIL TAKE the unpopular soul who neglects his pipe till it's gooey and offensive. Bliss is reserved (at 15¢ the tin) for those pipe lovers who tend their briars and fill them with sunny tobacco . . . like Sir Walter Raleigh. This heavenly mixture of mild Kentucky Burleys brings everlasting happiness to a man's tongue. It's well aged and seasoned. Fragrant—but eternally mild. Try it. It *may* be the smoke you hoped you'd some day find. (Kept fresh in gold foil.)

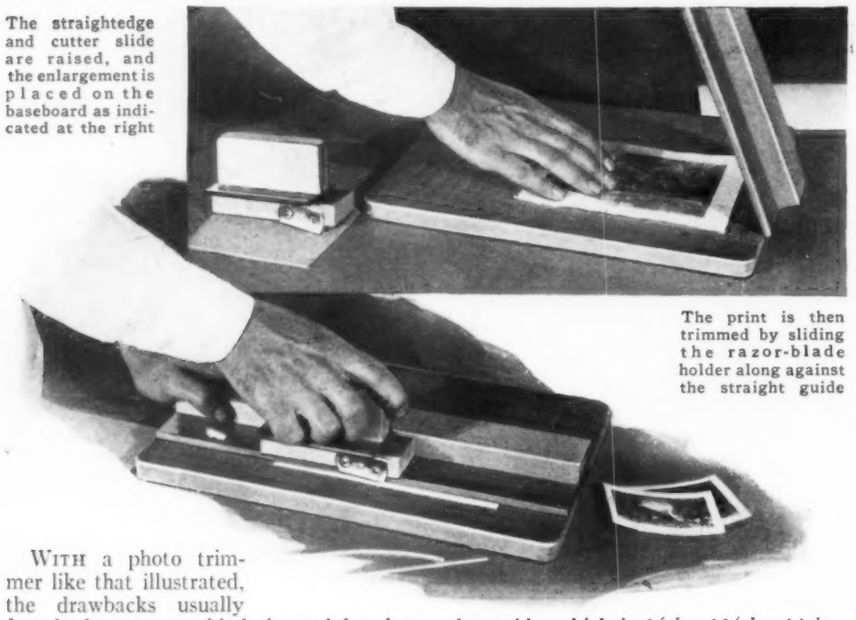
Brown & Williamson Tobacco Corporation
Louisville, Kentucky. Dept. Y-43.


How to TAKE CARE of your PIPE
SIR WALTER RALEIGH
SMOKING TOBACCO
FOR PIPE and CIGARETTES
"Sooner or Later— Your Favorite Tobacco"

Send for this FREE BOOKLET

It's 15¢—AND IT'S MILDER

Accurate Razor-Blade Cutter for Trimming Photos and Masks



The straightedge and cutter slide are raised, and the enlargement is placed on the baseboard as indicated at the right

The print is then trimmed by sliding the razor-blade holder along against the straight guide

WITH a photo trimmer like that illustrated, the drawbacks usually found where a razor blade is used for the cutter can be overcome, such as the difficulty of cutting a perfectly straight line or the danger of breaking the blade and cutting one's fingers. Not only can it be used for trimming enlargements or printing masks, but it is also easily adapted for cutting cloth or art leather.

The cutter slide, ¼ by 3¼ by 14 in. plywood, is nailed securely to the straightedge guide, which is ¾ by 1¾ by 14 in., and both are hinged to the baseboard—in this case a bread board that happened to be ⅝ by 10 by 14 in.

The device for holding the razor blade is constructed of three wooden pieces—a blade holder ¾ by 1¾ by 4¾ in., a finger guard of cigar-box wood ⅛ by 2¼ by 4¼ in., and a handle ¾ by 1¾ by 4¼ in. All three pieces are nailed together as shown. The razor blade is fastened at an angle to the holder with two small wood screws. It should project beyond the edge of the finger guard about ½ in., making it possible to sight down the blade for accurate cutting.

The blade holder is placed on the slide against the straightedge guide and slid from the hinge end to the bottom several times until the razor-blade corner cuts a groove about 1/16 in. deep in the baseboard, which helps to keep the blade cutting in a straight line when in use.

The photograph to be trimmed is laid under the slide and firmly held there by pressing down on the slide while the cutter is being drawn along it. Lining the baseboard off in ¼-in. squares makes it a simple matter to square up the photo prints.—ROBERT L. WILLIAMS.

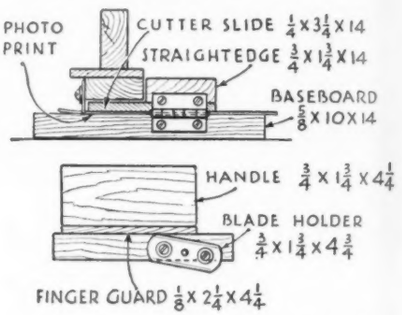
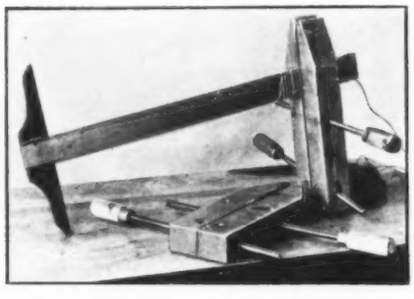


PHOTO PRINT
CUTTER SLIDE ¼ X 3¼ X 14
STRAIGHTEDGE ¾ X 1¾ X 14
BASEBOARD ⅝ X 10 X 14
HANDLE ¾ X 1¾ X 4¼
BLADE HOLDER ¾ X 1¾ X 4¾
FINGER GUARD ⅛ X 2¼ X 4¼

An end view of the complete trimmer and a side view of the sliding razor-blade holder



REPAIRING A T-SQUARE

T-SQUARES often get broken at the ends, and the celluloid edges spread. A simple way to make a permanent repair is as follows: Coat the broken edges with casein glue and wind the blade tightly enough with heavy string to draw the parts together edgewise. Then apply a hand screw or C-clamps to the faces.

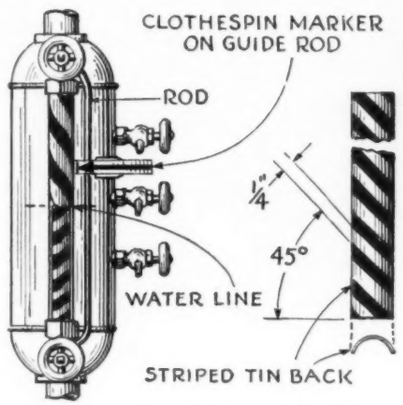
After a few hours remove the clamps and string, and scrape the joint smooth. If the edges need jointing, take the blade off the head, clamp a plane in a vise, bottom up, and draw the celluloid edges over the cutter. Finish by rubbing the edges over fine sandpaper.—E.M.L.

HOW TO CUT OILSTONES

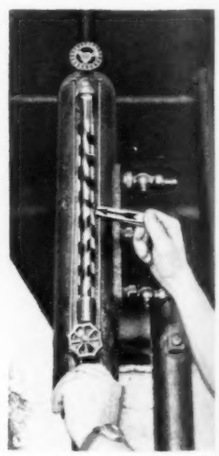
A CRACKED or broken oilstone can often be salvaged by cutting it off and making it into a smaller stone. This can be done by using an ordinary hack-saw blade set backwards in a frame so that the smooth edge does the cutting. A little kerosene or turpentine seems to help the cutting action.—V. C. DARBY.

WATER INDICATOR FOR STEAM BOILER

THE water level in the gage of a steam boiler is often rather hard to see since both the glass and the water are transparent. A simple way to make the water level clearly visible is to paint, alternate black and white stripes ¼ in. wide, across a piece of tin at an angle of 45 deg. and bend the tin in a semicircle so that it fits closely against the back of the water-column tube.



A piece of tin with black stripes is set behind the gage to make the water line visible



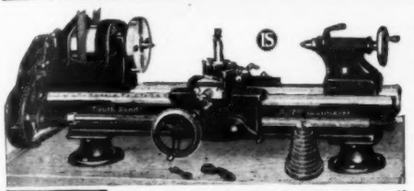
When viewed through the tube, the stripes that are seen through the air filled space seem to straighten up at an angle much greater than 45 deg., while the stripes seen through the water become more nearly horizontal. This makes it easy to see the exact level of the water at a glance. The effect is caused, of course, by the difference in diffraction between the air-filled and water-filled portions of the tube.

A pinch-type clothespin painted white with a black indicating arrow on it may be clamped on a rod adjacent to the water glass to serve as a convenient marker for judging the rising or falling of the water.—NORMAN V. DAVIDSON.

CLEANING PAINTBRUSHES

A 4-IN. wire brush on a power-driven flexible shaft will remove dried paint from paintbrushes without damaging the ferrules or bristles. Even though the paint has dried for several months, I have found it possible to remove every trace. The easiest way is to lay the paintbrush on a flat surface and move the wire brush, turning about 1,725 R.P.M. —W. MCCRATE.

NON-SLIP FLOORS
You can't slip on "61". Heel-proof, marproof, waterproof! No polishing! Dries in 4 hours. Lasts for years. Sold by paint and hardware stores. Pratt & Lambert-Inc., Buffalo, N. Y.
Quick Drying
"61"
FLOOR VARNISH
PRATT & LAMBERT
VARNISH PRODUCTS



$128 as shown

The 9" South Bend "Toolmaker" is a back-geared screw cutting lathe. Has ¾" hole in spindle; six spindle speeds; graduated compound rest; set-over tailstock for taper turning. Bed lengths 2' to 4'. 3' size weighs 325 lbs. Write for new Catalog No. 39 showing 18 other models of 9" Lathes as low as $108. Sent free, postpaid, on request.

South Bend Lathe Works
844 E. Madison St., South Bend, Ind.

12 and 15in. Flying SCALE MODELS

Your Choice of 10 Different Models

Any 2 for **50c**

Plus 10c Postage

Full fuselage Models, guaranteed to fly. Each complete in Construction Kit with all parts, materials and Plans and Instructions.

Monocoupe · Sparrow Hawk · Puss Moth · Polish Fighter · Fokker D-8 · Fokker Triplane · Boeing Fighter · Sopwith Camel · Heath Parasol · British S. E. 5

Send Stamp for New Bulletin

IDEAL AEROPLANE & SUPPLY COMPANY, Inc.
28 West 19th Street New York, N. Y.

This is written in one inch — the smallest advertisement accepted in this magazine.

WHAT CAN YOU DO WITH ONE INCH?

Small advertisements of one or two inches produce results of many times their cost for hundreds of companies or individuals who have novelties, scientific or mechanical equipment, tools, games, puzzles, etc., to sell, and for firms looking for agents. Inch advertisements like this cost $21.50. They pay well because they are seen and read by 400,000 wide-awake men every month. Interested parties are invited to address the Advertising Department, Popular Science Monthly, 381 Fourth Ave., New York, N. Y.

BIG SPARE TIME MONEY AHEAD

Take Orders for Popular Science Friends Buy it on Sight!

Learn How Easy It Is To Make Real Money in Spare Time!

MAIL COUPON TODAY

POPULAR SCIENCE MONTHLY
381 Fourth Ave., New York, N. Y.

Please send me full information free on how I can make big money in my spare time.

(NAME) .....

(ADDRESS) .....

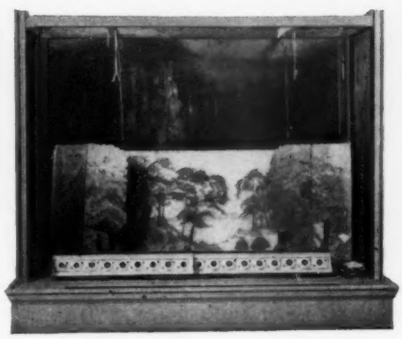
3-34

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

CURTAINS AND SCENERY FOR MINIATURE STAGE

(Continued from page 87)

plays are using modern settings with a black curtain at the back and sides. This curtain is known as the cyclorama or "cyc." To make a "cyc," duvetyne, monk's cloth, rayon, or velour in any color may be used. The two side walls are 18 in. high and 15 in. deep, and the back wall is 18 in. high by 30 in. wide. As a rule allow about 50 percent fullness in all curtains. It is well to run a chain weight through the bottom hem of a curtain to make it hang straight. Run a regular rod that has been bent to the desired shape through the top hem and hang it in place in the stage. One border 10 in. wide and 36 in. long will be sufficient.



Open stage with wood drop in the back, two wood wings set in place, and border lights

In an article to follow, Mr. Hicks will tell how to make the electrical equipment.

Winners of Indoor Photo Contest

PRIZES have been awarded as follows in the first of our winter series of indoor photo contests (P.S.M., Nov. '33, p. 68):

FIRST PRIZE, $25
L. DeS. Dibert, Philadelphia, Pa.

SECOND PRIZE, $15
O. A. Garmendia, New York, N. Y.

THIRD PRIZE, $5
M. Margossian, Berkeley, Calif.

FIVE PRIZES, $1 each
N. Desmond Taylor, Chicago, Ill.; H. J. Griffith, Dallas, Texas; Charles J. Belden, Pitchfork, Wyo.; A. L. Estep, Cicero, Ill.; W. R. Van Loan, Noroton, Conn.

HONORABLE MENTION—*J. E. Armstrong, Dallas, Texas; Lloyd J. Cartwright, Saginaw, Mich.; David J. Goldstein, Utica, N. Y.; A. O. Huntington, Harrison, Me.; R. D. Kershner, Philadelphia, Pa.; Mrs. Guy M. Page, Burlington, Vt.; Otis E. Powers, Union, Mo.; Lewis B. Simon, Cambridge, Mass.; Oscar Welander, Roslyn, N. Y.; M. G. Westerkam, Baltimore, Md.; W. Edward White, Plymouth, N. H.; and R. K. Wood, Chattanooga, Tenn.*

Winners of the December contest will be announced next month.

Replaces Wood with WOOD —The New Way to Make Home and Workshop Repairs

Repair damaged wood	Replace rotted wood
Holes in wood, plaster	Gaps along baseboard
Broken furniture	Reset loose castors
Even up chair legs	Reset loose drawer pulls
Reset loose screws	Reseal built-in tubs
Fill old screw holes	Fill drainboard cracks
Reset bathroom fixtures	Repair broken molding
Mend broken toys	Leaky window frames

1001 Other Valuable Uses

This marvelous new discovery—Plastic Wood—is just like putty when it comes from the can. It can be shaped or molded, or stuffed into cracks or holes quickly and easily by anyone—even if you're all thumbs. And when it dries it becomes hard, *permanent* wood that holds nails or screws without splitting—can be sanded, planed or carved—can be painted or lacquered—in fact, it can be treated just like regular wood.

With Plastic Wood on your workbench you can tackle any repair job with confidence—you know you can do it expertly. And if you make a mistake—if you take off too much wood with the saw, chisel, or bit—Plastic Wood is the only tool in the shop that can put wood back again—without any trace of the repair.

Don't be without Plastic Wood another day. Buy a 25c tube or 35c can at any hardware, paint or department store today. Fix up the things that need fixing and then keep Plastic Wood handy for future repairs.

NRA

PLASTIC WOOD

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS.

REAL PROFITS FOR YOU!

SHARPEN LAWNMOWERS AND EARN GOOD MONEY

Make $30 to $40 a week in your spare time

Build Your Own Profitable, Permanent Business

Anyone who wants to make good money either in his spare time or full time can do so by sharpening lawnmowers on the IDEAL Lawnmower Sharpener. Many men have made as high as $50 a week in their spare time alone. Most men will average around $30 to $40 a week. J. B. Van Dien, Ridgewood, N. J. writes: "Some weeks last summer I earned $40 a week with my Ideal Sharpener *just as a side line.*" H. Greenlaw, Fond du Lac, Wis., writes: "During May I sharpened over 200 mowers at not less than $1.00 each." Niles C. Race, Rochester, N. Y., writes: "I have to date sharpened 785 mowers at $1.00 each."

The Ideal Lawnmower Sharpener

Makes old, dull lawnmowers cut like new. It uses the correct principle of *grinding* the blades on a *grinding wheel*—the FACTORY method—and the method we have used for over 30 years. This produces the proper bevel or clearance and is the only way old, dull lawnmowers can be perfectly sharpened. Mowers run easier—stay sharp longer—customers come back year after year.

No Experience Necessary

No experience is required. Start right at home. Attach the Ideal to your lamp socket. Blades are automatically ground to fit the cutter bar without taking lawnmower apart. You can sharpen any make of lawnmower in 15 to 20 minutes—you get $1.00 to $1.50, depending on size and condition of mowers. New attachments also grind skates, grass shears, hedge shears, sickles, scythes, axes, gum saws, etc.

Now is the Time to Start

The time to get started is NOW. It isn't a bit too early to solicit lawnmower sharpening business. Send coupon or post card today for our

free CATALOG

THE FATE-ROOT-HEATH COMPANY
347-378 Bell St., Plymouth, Ohio

Send me your free catalog and tell me how I can make Good Money with the Ideal Lawnmower Sharpener.

(Please PRINT your name and address)

Name_____

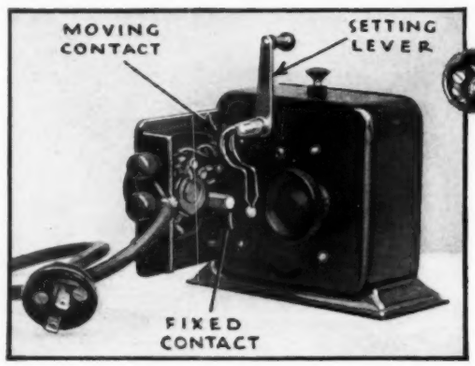
Address_____

City_____ State_____

Alarm-Clock Time Switch

turns on heat in morning

BY J. L. BIRD



The front and back views of an alarm clock fitted with a contact device for use in a heat-control system. It energizes a relay at a predetermined hour

AFTER the heat-control equipment described last month (P. S. M., Feb. '34, p. 74) has been installed and operated for a short time, the builder will undoubtedly wish to add a device that will automatically cause the furnace draft to be opened at a predetermined early hour in the morning. This will enable him to maintain a lower night temperature and still have the rooms warm when he arises in the morning. Such a device effects an additional fuel saving.

The construction of this extra equipment is comparatively simple and requires no alterations to the existing heat-control system. It consists essentially of an inexpensive alarm clock fitted with a simple contact device and a relay similar to the one already used in the control system.

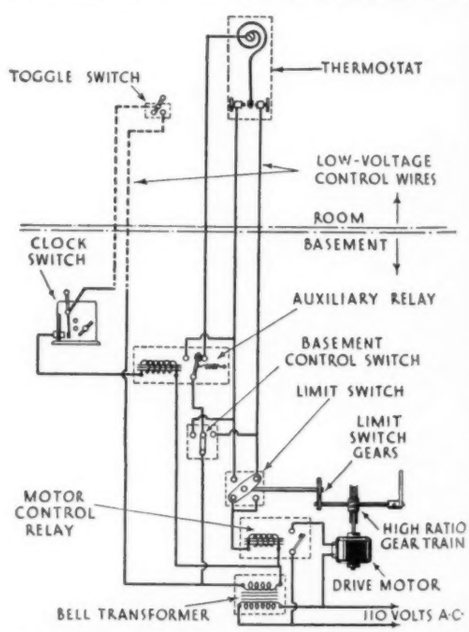
Assume that the night temperature has been set to 65 deg. F. with the thermostat. This temperature will be maintained throughout the night until the predetermined time set on the alarm clock is reached. At this point the alarm part of the clock will close an electrical contact and cause the auxiliary relay to be energized. The relay takes control away from the thermostat and at the same time completes a circuit causing the motor unit to open the furnace draft. This action will open up the fire to provide a comfortably warm room by the time the builder is ready to get up. When the auxiliary relay coil circuit is de-energized, control will then be automatically restored to the thermostat, which now can be adjusted for the day temperature.

The alarm clock may be of the dollar type. Select one that has rigid wings on the winding keys. Wind up the alarm spring until it is almost fully wound. Now fasten to the alarm winding key a contact arm about 1½ in. long. Mount on an insulated block a fixed contact and fasten this to the clock case in a position where the moving contact attached to the winding key will strike it when the alarm is set off and the key unwinds. When this occurs and the contacts close, further unwinding of the alarm spring is prevented.

One photograph shows the back of an alarm clock fitted with such a contact arrangement. (It will be noted that there is also a rotary switch on the clock, but this is for another application and may be ignored.) It is suggested that the builder fit the alarm winding key with a short lever that projects above the case, as shown. This will serve as an easy method to reset the moving contact and at the same time wind the alarm spring. Connect one wire to the moving contact and the other to the fixed contact mounted on the insulated block. These wires are the connections to the auxiliary relay coil circuit.

The relay may be constructed in a manner similar to the one used with the regular heat control system. The contact arrangement, however, should provide a normally closed circuit when the relay is not energized and make another circuit when the relay is energized. This is accomplished simply by adding to the relay base a contact post that will touch the moving contact on the relay armature when it is open. The spring on the armature, which serves to keep it open, will also provide the necessary contact pressure for this back contact—the normally closed one. The relay coil voltage should be the same as the one used with the original control system.

This auxiliary relay may be mounted in any convenient location, near or on the motor drive unit. The wiring diagram shows



Wiring diagram of heat-control equipment with a clock switch to open draft early in the morning

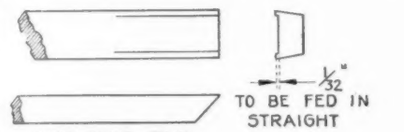
how all the connections should be arranged for both the contacts and the coil circuit.

An extra convenience for easy control of the clock action may be had by running a pair of wires up to the thermostat location. These should terminate in a small toggle switch. Illustrations in the previous issue show this switch mounted in the bottom of the thermostat case. This switch is connected in series with the auxiliary relay coil circuit. After the clock contact has energized the relay coil to take control away from the thermostat at the desired early hour, it can be regained later in the morning by snapping this switch to the "off" position. It is not necessary to go to the basement to open the clock contact. However, this extra feature is just a convenience and by no means essential for the operation of the clock control. The circuit for this feature is shown dotted in the wiring diagram.

A time-switch system such as has just been described will enable the builder to save considerable fuel by maintaining a fairly low night temperature, yet the house will be warm when he arises in the morning.

SPECIAL TURNING TOOLS SIMPLIFY LATHE WORK

FOR parallel cutting or the fashioning of a deep shoulder in soft, coarse grained woods, few tools can equal the cutting efficiency of the shape shown in Fig. 1. The



SLIDE REST TOOL FOR WOOD TURNING

FIG. 1

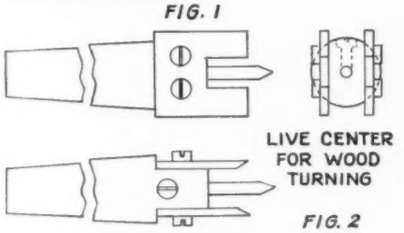


FIG. 2

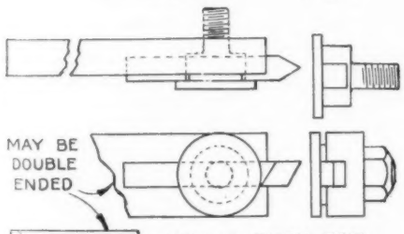


FIG. 3

A scraping tool, built-up live center for wood turning, and holder for thread-cutting tools

two corners enter slightly beyond the cutting edge of the scraper and tend to break up the chips as they are formed.

In general use, the live center illustrated in Fig. 2 has few rivals. When used in split turning, the driving blades tend to hold the pieces together.

A tool holder for use in cases where threads are to be cut with two or three tools is illustrated in Fig. 3. The various tools can be taken out and replaced without any adjustment to the tool holder. The holder can also be made double ended for use with tools having an angular pitch.—GEORGE P. SHARP.

MAKING EXPERIMENTS WITH "BLACK LIGHT"

(Continued from page 68)

screen wire. The frame can be attached to the lamp support or provided with legs so that it can be set anywhere.

Even without buying a piece of ultraviolet glass, you can experiment with black light at a cost of about 50 cents for one of the new 2-watt glow lamps filled with argon gas. This is similar to the familiar split-disk type of neon glow lamp except that it produces a visibly blue light. It is rich in near-ultraviolet light in the region from 3,500 to 3,800 Angstrom units of wave length. It will operate on direct or alternating current at 110 volts. Since it is not a very strong source of ultraviolet light, it must be used close to the objects, ordinarily within a few inches. (For advanced work in laboratories and museums, very powerful fluorescent lamps are available. These are Cooper Hewitt lamps equipped with a mercury-vapor arc in a tube of nickel cobalt glass.)

THE small argon glow lamp is intended for use chiefly in producing fluorescence—that is, making other substances glow with visible light. A jar of vaseline placed near it will give off a ghostly glow. If brightly colored silk handkerchiefs are held near the lamp, some of the dyes will glow with weird, firelike colors. Some forms of glass beads and buttons fluoresce vigorously in its light.

The action of ultraviolet light on minerals is so interesting that one company has prepared a collection of ten mineral specimens that give off light of various hues when exposed to the invisible rays, and is offering these, together with an argon glow lamp, at less than five dollars. You can pick up pieces of rock almost anywhere that will react to ultraviolet light.

The faces of your friends, seen in ultraviolet light, will take on a startling appearance. One of the first things you will notice is that the teeth are fluorescing. Finger nails react like the teeth, but with less brilliancy.

If you are fond of amateur theatricals, you can introduce variety into performances by using the luminous paint and ultraviolet colors sold for this purpose on parts of the costumes, props, and scenery. When ultraviolet light from one or more properly screened sun lamps or photoflood lamps is directed on the otherwise darkened stage, the paint emits visible light, even at a distance of several feet from the light source.

If you are an amateur photographer, you can photograph various articles in the light from an ultraviolet lamp. The use of black light for detecting forgeries and other alterations of written documents, with the aid of the camera, is well known (see P. S. M., Oct. '31, p. 36, and Dec. '32, p. 75).

The region of ultraviolet light is divided by scientists into three parts. It is the so-called "near" ultraviolet that passes through glass, makes possible the taking of photographs, and causes most of the fluorescent effects described. "Middle"" ultraviolet is not transmitted by ordinary glass, but does pass through the special bulbs of various lamps such as the S-1 and S-2 sun lamps, the G-1 and G-5 glow lamps, and the CX lamps used in poultry work. This is the ultraviolet which creates vitamin D and is beneficial to health. The short-wave ultraviolet region requires quartz for its transmission, kills germs and is injurious to unprotected eyes. Such short-wave radiation comes from quartz-mercury arc lamps such as you find in doctors' offices, from carbon arcs, and similar sources.

However, in your ultraviolet experiments with photoflood, S-1, argon, or similar lamps, you need have no fear of injuring your eyes if you do not look directly at the unshielded lamp (excepting the argon bulb, which causes no harm).

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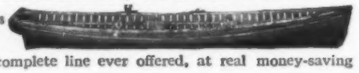

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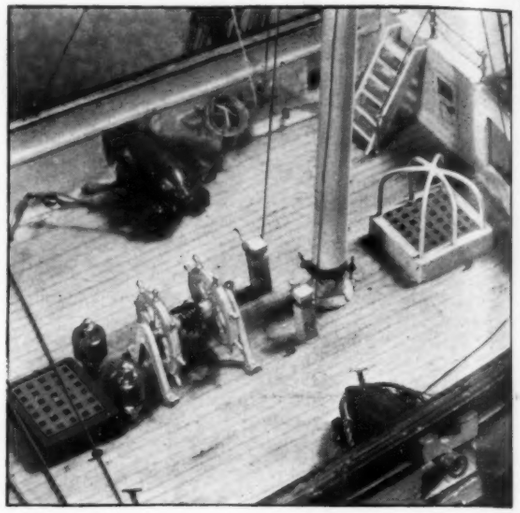
DECK FITTINGS FOR *HARTFORD* MODEL

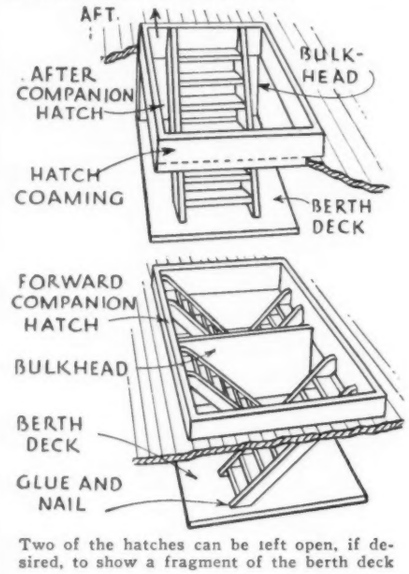
(Continued from page 71)

already made the cable bitts. The bower (anchor) cables lead down chain pipes alongside the second hatch, and the stream anchor cables down similar pipes by the hatch abaft the capstan. These will be sections of tube large enough to take the cables. Along the deck are chocks marked *Z* to keep the cables off the deck; they are merely square blocks with a groove on top to take the chain. Up to the forward pipes the chocks are double.

Fife rails are needed around the foremast and mainmast. These can be cut to shape (see *T1* and *T2* on the deck plan) from a piece of hardwood or fiber board. They are each supported on three turned stanchions. The outside stanchions each have two holes bored *fore-and-aft* to represent the sheaves for the topsail sheets and topping lifts. The rails will have about eight be-



The double steering wheel with the two binnacles; the foot of the mizzenmast; and a hatch with crossed wires



Two of the hatches can be left open, if desired, to show a fragment of the berth deck

laying pins in each. At the mizzenmast it is slightly different, since there are only the topsail sheet bitts and no rail (see *T3*)

There are two steering wheels separated by the drum on a shaft. They are supported by iron brackets outside the wheels. The wheels, made as neatly as possible, should be about 5¼ in. in diameter. The whole assembly is built and the ends of the supporting standards nailed to the deck. If a piece of small chain is wound a couple of times around the drum and the ends run through holes in the deck, it will give a realistic appearance.

The binnacles marked *S* are round. The originals are of mahogany, with sliding doors on the after side to disclose the compasses within. They stand on turned brass standards and have brass lamps let into the tops.

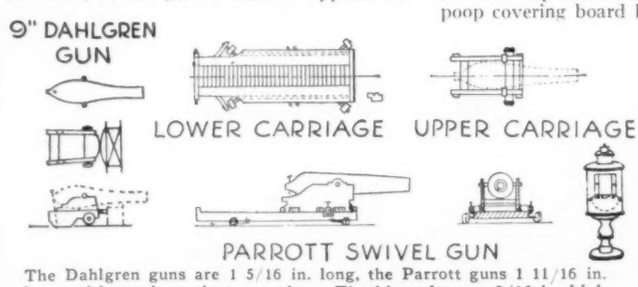
There are four ladders *P*: a central one to the forecastle head, one on each side to the poop, and one to the gangway platform. This platform *X* is a square grating, supported on a batten on the bulwark and two stanchions, which extend up as shown in a sketch last month. Through the stanchions a rope from the gangway board is rove and extended to another stanchion at the foot of the ladder. As these platforms are in the way of working the guns, I presumed there would only be one, which could be shifted across the deck if required.

Up in the bows, in line with the inside of the sides of the stem, are the knightheads *BB*, ⅛ in. square and ½ in. high. On them is fitted a short pinrail to take six belaying pins for the jib outhauls and downhauls. On the after end of the forecastle I showed the ringbolts, three on a side, and just abaft them the fair-leads for the jib sheets.

On each side of the forecastle and poop will stand a pair of wooden mooring bits *U*. They are a full ⅛ in. thick with crossbars half of that, half-lapped in.

Firmly fastened to the main rail on the inside are five sections of pinrail, each side, as shown on the deck plan. They are just hardwood pieces drilled to take the belaying pins, which may be inserted now or later. It looks best to put pins in all the holes, but only part of them will be used as we have no sail gear rove. On the poop there are similar rails, but supported on turned stanchions.

Mooring line fair-leads or chocks are let into the cap rail forward and placed on the poop covering board below.



The Dahlgren guns are 1 5/16 in. long, the Parrott guns 1 11/16 in. long, with carriages in proportion. The binnacles are 9/16 in. high

Around forecastle and poop there will be protection rails of ¼-in. two-ball stanchions with thin wires run through. The dots on the deck plan show the approximate position of these. The holes may well be drilled now, but the stanchions are better

(Continued on page 93)

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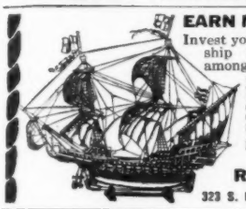

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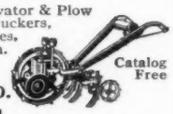

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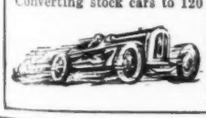

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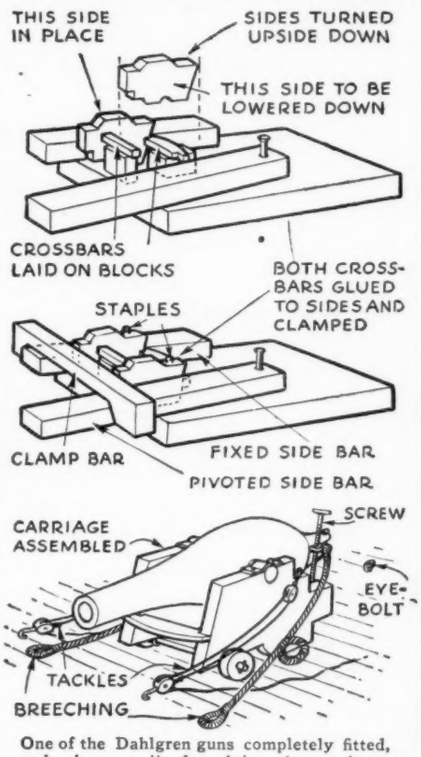
DECK FITTINGS FOR *HARTFORD* MODEL

(Continued from page 92)

left until the finish with the exception of the short sections on the fore side of the poop, the top wire of which I extended down to stanchions at the foot of the ladders. I found No. 34 wire best for reeving through the stanchions.

Though it hangs on the mainmast, the bell is part of the deck fittings. It is about ¼ in. high and the same across the mouth. It hangs from a bracket fixed to the mast so that the tongue is ¾ in. from the deck.

During the Civil War period, the *Hartford* carried twenty-two 9-in. Dahlgren guns. The lines for them shown are taken from a contemporary naval instruction book. They are best cast or turned from bronze and oxidized. The carriages are quite tedious to assemble, so I made a jig as shown for gluing them together. It should be oiled to prevent the



One of the Dahlgren guns completely fitted, and, above, a jig for gluing the carriages

parts sticking to it. Before removing each carriage, drive in the two staples for the wheel axle. Put in two more staples on the after step for the tackles. Lay the gun trunnions in their notches; then cut thin strips of brass, bend to shape, drill holes in each end, and use pinheads to nail the guns in position. Next make the wheels, bored to fit tightly on the axles, and glue in position. Note that there are only two wheels. These guns were not raised with wedges, but by a screw with a crossbar through the end and working in a ring at the breech, to one side. I threaded some No. 20 hard brass wire and soldered little crossbars to the ends, but instead of finishing it at the crossbar of the carriage, I bored through that and drove it into the deck, which looks the same but holds the gun in position, with the aid of a touch of glue under the carriage. I then put a touch of liquid solder where the screw touches the breech.

To take the recoil, these guns have rope breechings, which have to be long enough to allow the muzzle to jump back clear of the bulwark. I spliced *(Continued on page 94)*

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The Popular Science Monthly

381 - 4th Ave. New York

DECK FITTINGS FOR *HARTFORD* MODEL

(Continued from page 93)

eyes in the ends of the breeching and seized them to loose eyebolts. Next I took a half turn on each side, which I kept in shape with a turn of thread; then slipped the middle in the slot in the cascabel, and pressed the eyebolts into the holes bored in the bulwarks.

The guns also require tackles on each side. These consist of two single blocks from the carriage to bolts in the bulwarks. One bolt is driven centrally between each pair of guns for this purpose. I found it best to strap these 3/32-in. blocks with wire, forming a hook. The tackles are rove, the blocks hooked and hauled tight, and the ends hitched around all parts.

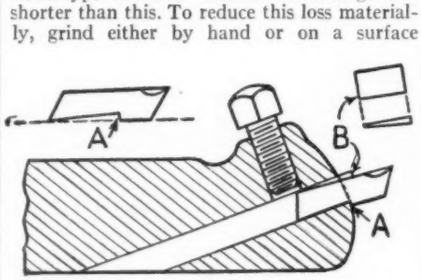
There are also two larger Parrott swivel guns. The carriage proper for these slides on another long carriage to which they can be clamped with screws at the sides. The lower carriage has swivel wheels so that it can be moved to point in any direction on the tracks shown on the deck plan. I made these tracks of cardboard, painted black and glued down. The lower carriages should have at least two tackles on a side to ringbolts in the deck, but had better also be nailed down.

There should be a ringbolt as nearly midships as possible back of each gun for the inboard-haul tackles, which need not, however, be rove. Guns and carriages are all black, and tackle blocks brown or black.

(To Be Continued)

USING SHORT TOOL BITS IN STANDARD HOLDER

ABOUT 1 in. of every ordinary 5/16-in. tool bit is wasted because it cannot be clamped securely with the set screw of the usual type of holder when it has been ground shorter than this. To reduce this loss materially, grind either by hand or on a surface



Method of notching a short lathe tool bit so that it can be wedged in an ordinary holder

grinder a step in the bottom of the discarded bits as shown at *A*. When put into the holder, the bit then cannot be forced back by the cut farther than the end of the step, which strikes the bottom lip of the hole. This, however, leaves an opening at the top that is wide in front and tapers toward the back.

A discarded power hack-saw blade is now broken off at one end and ground into a wedge about ½ in. long and 5/16 in. wide as shown at *B*. It is then nicked with the wheel and broken off. Some care should be used in making this so that it can be used with many other bits. This wedge is driven in tight on top of the bit with the side that has been ground facing it. This will hold the bit more securely than when clamped with the screw, yet the bit may be readily removed by driving it out with a punch on the inner end.—George J. Murdock.

LACQUER AIDS IN ETCHING

Because it does not chip off, brushing lacquer is better than asphaltum or wax for etching metals with acid.—D. H.

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Up-to-Date Station

Improves Model Railway System

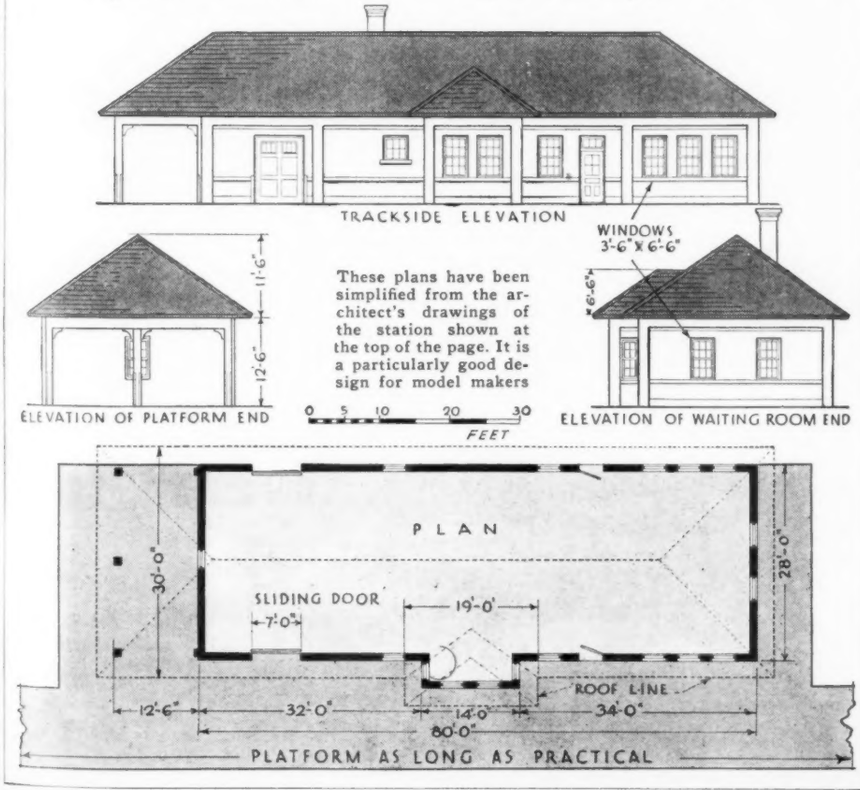
By J. W. CLEMENT

THE traveling public always judges a railroad by its service, equipment, and station facilities. For this reason every model railway system should have an up-to-date station, not elaborate and not too plain.

Plans for a combination passenger and freight depot are given below. They show brick construction. Some of the tiresome labor of making imitation brick may be eliminated by building of stucco, using coarse sandpaper painted gray or tan. In either case the roof should be a tile red with window frames and sash, door frames, and posts under the covered platform painted dark red. The doors should be painted dark gray with light gray panels. The wheel guards on the freight door frames are painted black. The station sign, if any, should have a black background and white letters.

For a brick or stucco depot we can hardly escape making a brick platform. This should not be too difficult, however, if a reddish tan linoleum is used and the bricks are outlined with ink. The outer edge should be painted gray to represent the concrete curb. Let the platform be as long as practical.

Use your own good judgment as to materials, but stick to the plans so that your depot will be correctly proportioned. The size you make it will depend, of course, upon the scale of your model railway. The scale given with the drawings represents feet, and with it you can find the actual size of any part of the depot. If, for example, you wish to build the station on the scale of ⅛ in. equals 1 ft., then each of the small divisions at the left end of the scale should be taken as ⅛ in. in building your model.



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—says Mr. Robotham of San Francisco

For an American to be known abroad by the tobacco he smokes is significant. The makers of Edgeworth Smoking Tobacco are deeply grateful to smoker Norman H. Robotham of San Francisco for his account of his experience in foreign countries.

1527 Anza Street
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June 7, 1933

The Corn Cob Pipe Club
Richmond, Va.

Gentlemen:

Listening tonight to your program I felt that I owed it to your club to report my experiences as an Edgeworth smoker.

Three years ago while on a visit to Europe I had some unusual experiences. Seven different times in five different countries I was asked by total strangers, "You're an American, are you not?" and in each case I surprisedly asked, "Why do you think so?" Imagine how I felt when in each case I found that they had identified me by Edgeworth smoking tobacco.

Riding on a train in France an Englishman after watching me for some time spoke up as follows: "Pardon me, but I can't resist any longer asking you for a pipeful of that beautiful tobacco. Edgeworth it is I know, and rude as it may seem, I am just dying for a smoke of it."

When you quit making Edgeworth I'll quit smoking.

Respectfully yours,
Norman H. Robotham

There is something a bit special about this particular brand of tobacco which you ought to experience. So ask your tobacconist for Edgeworth. Try it once. Learn to know this rare combination of true tobacco flavor with genuine mildness. A small pocket package will cost you but a few cents. If you do not like it, you will be "out" only a few pennies. Edgeworth may be a real "discovery" to you. Then you will be glad you tried it.

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The Corn Cob Pipe Club, to which Mr. Robotham addresses his letter, is the radio program of Edgeworth Tobacco. It is on the air every Wednesday evening at ten o'clock, Eastern time, over the WEAF Coast to Coast network of the National Broadcasting Company. You are invited to tune in and join the group of country people having a big time at the old Cross Roads hall down in Virginia.

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THE NATIONAL HOMEWORKSHOP GUILD

(Continued from page 67)

larger cities. The larger the club, the more varied will be the hobbies represented. This increases the interest of the club as a whole and also provides manifold topics for discussion, demonstration, and club projects.

Inquiry: Are groups of boys aged 16 and 17 too young to form an affiliate club? *Answer:* No. The minimum age is 16.

Inquiry: Does the Guild intend to create a committee or department for various types of homecraft work? *Answer:* No. The craftwork sponsored by the Guild embraces all the branches, and the Guild does not intend to specialize in any one branch.

Inquiry: Does the territory of the Guild extend into Canada? *Answer:* The National Guild will accept affiliated clubs from Canada.

Inquiry: I am 14 years old. Can a group of my friends of about the same age form a junior club, as they are all much interested in homecraft work? *Answer:* The Guild has not yet completed arrangements for the formation of junior clubs. It is suggested that you and your friends endeavor to interest older members of your families in the formation of a club. They, in turn, could then organize a junior home workshop division of that club.

The local clubs already fully organized at the time this is being written, and their officers, are as follows:

Amarillo Homeworkshop Club, Amarillo, Texas—Dr. W. R. Moody, president; H. B. Vaughn, vice president; D. C. Regal, secretary-treasurer.

Amateurs Homeworkshop Club, Richmond, Va.—Floyd E. White, president; F. W. Harrison, vice president; Forrest H. Stairs, secretary-treasurer.

Cleveland Homeworkshop Club, Cleveland, Ohio—Thomas B. Owens, president; Parker Howard, secretary; Thomas B. Graham, treasurer.

Cody Homeworkshop Club, Cody, Wyoming—E. T. Tricket, president; F. J. Worst, secretary; Stanley Langren, treasurer.

Denver Homeworkshop Club, Denver, Colo.—A. D. White, president; George H. Wilson, vice president; Leonard Stebbins, secretary-treasurer.

Dixon Homecraft Club, Dixon, Ill.—A. G. Oberg, president; Carl H. Fisher, vice president; E. W. Gerdes, secretary-treasurer; H. H. Emmert, librarian.

Fairfield Hobby Club, Fairfield, Ala.—J. Duke Haney, president; Roy B. McEachen, secretary; Herbert Barnett, treasurer.

Flint Homeworkshop Club, Flint, Mich.—Bernard Schlegelmilch, president; Ivan Meade, secretary; Francis R. Voight, treasurer.

Glen Lyon Homeworkshop Club, Glen Lyon, Pa.—John Domzalsky, president; Charles Cragle, secretary; Willard Hoffman, treasurer.

Hemlock Homeworkshop Club, Sharpsburg, Pa.—Joseph A. Smith, president; Joseph B. Mahon, vice president; Joseph H. Mary, secretary; Raymond M. Lester, treasurer.

Jaynesville Homeworkshop Club, Jaynesville, Wisc.—Alan W. Dunwiddie, president; A. G. Weaver, secretary-treasurer.

Hill Top Homeworkshop Club, Cincinnati, Ohio—Charles Griffith, president; Willard Baumer, secretary; David Huber, treasurer.

La Grange Homeworkshop Club, La Grange, Ill.—W. W. Cranford, chairman; H. C. Fletcher, vice chairman; F. W. Teeter, secretary-treasurer.

Leatherstocking Homeworkshop Club, Cooperstown, N. Y.—Myron E. Clapsaddle, president; LeRoy L. Parshall, secretary; F. G. Shepard, treasurer.

Lumber Jack Homeworkshop Club, N. Tonawanda, N. Y.—Howard Fritz, president; J. Carlton Gordon, secretary; Milton Krum, treasurer.

Morristown Homeworkshop Club, Morristown, N. J.—E. A. Carpenter, president; K. C. Bates, secretary-treasurer.

Rockford Homecraft Club, Rockford, Ill.—LeVern T. Ryder, president; William Bauer, vice president; E. Raymond DeLong, secretary; R. A. Horner, treasurer.

Silverton Homeworkshop Club, Silverton, Colo.—D. E. Smith, president; E. S. Davis, secretary; D. M. Wyman, treasurer.

Topeka Homeworkshop Club, Topeka, Kans.—Clyde F. Cook, president; Richard Kerr, vice president; Wellington W. Culver, secretary; L. L. Glass, treasurer.

Vineland Craftsmen's Guild, Vineland, N. J.—John W. Dennis, president; John S. Harker, secretary; Bernie S. Halversen, treasurer.

Wood-Ridge Homeworkshop Club, Wood-Ridge, N. J.—L. J. Messenger, president; G. N. Schalk, secretary-treasurer.

As the official magazine of the Guild, POPULAR SCIENCE MONTHLY will report the organization of all new clubs and give a list of their officers.

National Homeworkshop Guild
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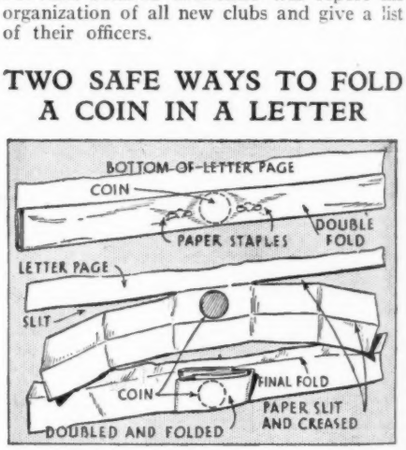
TWO SAFE WAYS TO FOLD A COIN IN A LETTER



In one method the coin is held by folding and stapling; in the other, by folding alone

RECENTLY I hit upon a kink for sending small coins through the mail that is better than any other method with which I have had experience. I fold the coin into the lower portion of the letterhead itself and, by means of an ordinary paper fastener, staple both sides so that the coin can't be taken out without tearing the paper. It becomes part of the letter.—W. F. SCHAPHORST.

A somewhat similar method is shown in the second sketch. It has the advantage that no stapling machine, paste, or paper fasteners are required.—THE EDITOR.

MICROSCOPE ADVENTURE IN A FISH BOWL

(Continued from page 49)

cannot hope to see all of them, unless you spend the rest of your life in the study of nothing else.

Perhaps the most beautiful scene that the aquarium offers is provided by the fish scale. Take, for example, a goldfish, preferably one recently dead. It, like many other fishes, has scales of the cycloid type. Scales from different parts of the body differ in appearance. Those, for instance, from the lateral line—the line that runs from head to tail along the side of the body—are equipped with tubes through which it is believed some kind of secretion takes place. Scales from other areas have no tubes.

CYCLOID scales generally are marked with lines running about a common center, crossed by a few radiating ribs. The clear, uncolored portion of an individual scale is that part which was beneath another scale or scales. In the projecting portion, you can see the chromatophores, like those that made Pete so beautiful. These are contained in a membranous covering that you can scrape off with a dissecting needle.

Remove this covering from two or three scales and crush the mass thoroughly in a drop or two of water. You will see the water take on an iridescent, pearly appearance. Remove the large solid particles and drop a cover glass over the water. Place the slide on the microscope stage and adjust the focus.

Before your eyes, you can see one of the most interesting things in nature—the particles that produce the pearly luster of a fish. In the microscope field are hundreds of them, dancing restlessly about, throwing shafts of light every way like a mass of moving diamonds. Examination reveals that they are thin, flat, transparent plates. Moving restlessly, perhaps because of a slight agitation of the water, they act like tiny mirrors, each catching a ray of light, directing it momentarily up the microscope tube and then turning so that it becomes almost invisible.

These plates or spicula or iridocytes, are seen best by reflected light, although they are visible by transmitted light when a small condenser stop is used. A good way to illuminate them is to place the microscope so that light from the sun or an electric bulb falls upon the microscope stage, and is not reflected upward by the mirror. A dark-field illuminator can be used if available.

FISH-SCALE spicula are found in many fishes besides the one you are examining. They seem to be about the same size and shape, no matter what the size of the fish. As an item of commerce, they are important. They are constituents of the fish-scale essence that is being used in automobile lacquers, toilet articles, glass beads, and elsewhere for producing a pearl-like appearance.

But you have only begun to explore your aquarium. Snails, placed so that they will hang from the bottom of a glass slide, and illuminated from above, are entertaining. It is fun to watch their rasplike tongues scour the glass for food. When the aquarium glass becomes covered with green algae, the snails travel over it, scraping off the vegetation. Their tongues are set with hundreds, even thousands of teeth. The pond snail makes a good specimen to study because it is not too big to hang suspended through the hole in the microscope stage. Its toothed tongue operates like a sanding belt when it feeds.

The chances are that you will find patches of snail eggs on the aquarium glass or plants. Scrape these off with a razor blade and examine them at *(Continued on page 98)*

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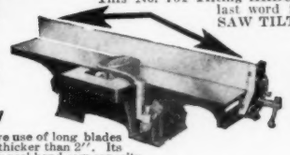

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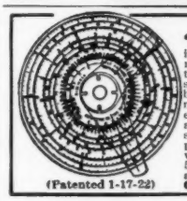

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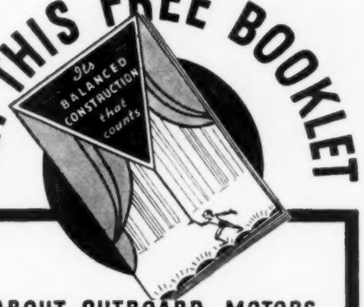

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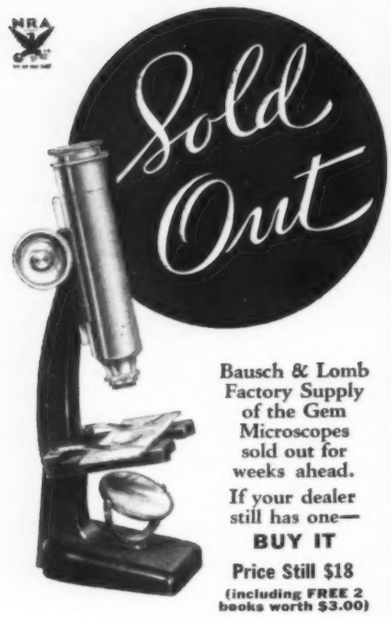

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MICROSCOPE ADVENTURE IN A FISH BOWL

(Continued from page 97)

various magnifications. Newly laid eggs exhibit prominent nuclei. It is interesting to watch these spots change gradually, over a period of days, into tiny snails that crawl about inside the egg for a time before emerging into open water.

Daphnia, a water-flea related to the shrimp and lobster, is a common form of food for fish. You can get these little creatures from almost any fish dealer. Put one of them under your microscope, and you will get the impression that you are gazing at an active piece of machinery. One observer remarked that, "It's just like a printing press."

THE water-flea, which normally darts about erratically, is held in one position by the cover glass of the micro-aquarium you constructed for observing Pete, the tropical fish. But it does not remain motionless. The black eye that resembles a cog-wheel vibrates back and forth for no apparent reason. The digestive gland and forward end of the intestinal tract which serves as a stomach, pump constantly, churning the food and digestive juices. The tiny heart vibrates rapidly, circulating the almost colorless blood. The swimming feet beat the water in an attempt to propel the body. If the flea is a female, the chances are that her brood pouch will contain six to ten young which, in turn, are kicking their feet and otherwise contributing to the action. The outer shell of the daphnia has an interesting texture.

Your exploration of the aquarium will include examination of the plant life there. Scrape some of the green algae from the glass or larger plants, put it upon a slide and examine it. You will find myriads of little green plants resembling jointed sticks, clubs, and a host of other things. In this microscopic forest, you will see awesome creatures—the rotifer, sterntoor polymorphus, paramecium, amoeba, and dozens of other creatures, some of which have been described in previous articles of this series. The giant of the algae forest is nais, a small worm related to the earthworm, and just barely visible to the naked eye.

Perhaps you will want to preserve some of these wonders for future reference. Fish scales, properly dried water-fleas, and other interesting specimens can be mounted easily. This brings us to the fascinating subject of slide making, and to a little time-saving device that will improve the quality of your slides.

Cover glasses, cemented in place with balsam, sometimes come loose and admit air bubbles before the balsam is dry, thus ruining the slide. This is particularly true when cells of shellac or celluloid are used. By clamping the cover glass down against the cell or slide such troubles are avoided.

SHOWN in the pictures is a clamp that will do the trick nicely, and is easy to construct. It can be made in almost any size, to accommodate any number of slides at one time. The device consists essentially of a wood block on which the slides rest, and a battery of spring plungers arranged so that they will press against the cover glasses. Plungers in the model shown are empty film spools from a small camera. Of course, other types of spools can be used, or you can make little plungers out of hard wood.

Because the spools used have ends that are fastened tightly in place, the block through which they operate was split, the holes bored, the plungers inserted, and the two halves *(Continued on page 99)*

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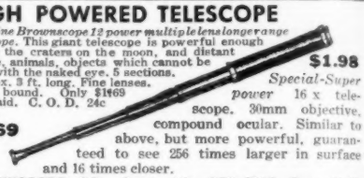

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MICROSCOPE ADVENTURE IN A FISH BOWL

(Continued from page 98)

fastened together again. The springs were made by wrapping light piano wire around a three-eighths-inch rod, letting it unwind to relieve tension, and then forcing sections of proper length over the spool spindles. Dimensions of the parts are given in the drawing. These will vary slightly for different spools. Adjust the spring tension by cutting pieces from the wire, until a gentle pressure, not sufficient to break a cover glass, is exerted.

If you use your microscope for taking pictures of the wonders of the invisible world, it will pay you to investigate some of the more recent lighting devices. The small-size flash bulbs introduced not long ago make it possible to photograph live insects, protozoa, and other moving objects. Flood lamps, the kind that produce 750 watts of light for two hours and cost thirty-five cents, are excellent for making exposures of specimens that do not move.

A SATISFACTORY way of using flood lamps involves a four-inch piano-convex condenser lens. Place the lens from twelve to eighteen inches from the microscope mirror, and the lamp, preferably in a suitable reflector, six inches or so beyond the lens. Line up the lamp and lens until a bright beam is centered on the mirror and the illumination is even on the object. You will have to judge exposure on the basis of experience, but you will find that the flood lamp permits fairly short exposures and produces even illumination without much fussing.

Now if you want to photograph moving specimens, proceed as just outlined, until you have the image focused and centered properly. Then turn off the current, remove the flood lamp and insert in its place a flash lamp. When the camera is ready for the exposure, fire the bulb by turning on the current—and you have your picture. The condenser lens is necessary for best results. The flash lasts about one-fiftieth of a second, which is ample for most purposes. You will find in the fish bowl many fascinating little animals that will not pose willingly for the usual time exposure, but which can be kidnaped easily with a fifteen cent flash bulb.

RAISE EXPERIMENTAL HOPS IN FAKE SPRING

FAKE winters and artificial springs are enabling workers at the Oregon State College to speed up their fight on the downy mildew disease which attacks hops. The plants, which usually require five years to bear, produced hops in three years under the laboratory schedule of controlled temperature. After being packed in sand and peat moss, they are frozen for a certain length of time and then subjected to spring heat. Although it is autumn outside the laboratory, the hops act as though a new spring had come and sprout or put on leaves. By this time-saving method, the workers have produced several hybrid seedlings which are valuable as breeding stock, as well as testing out varieties of hops for their resistance to the mildew disease.

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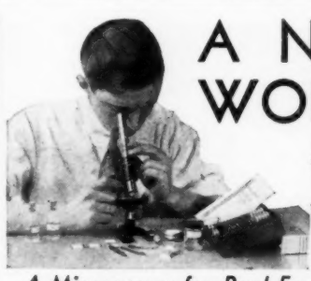

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SLOSHING about on slippery decks and puddled docks, going wearily home with wet feet and dreading the next day when he must worm them into dry, harsh leather, it is no wonder that Allen Drury began to study the subject of shoe grease. That was five years ago when he was a longshoreman on the docks of Portland, Oregon.

Now he is the manufacturer of a waterproof leather dressing, in the early development of which his own aching feet were his principal testing laboratory. His business is now well established among the jobbers and dealers of the Pacific North West. A great chain of sporting goods distributors has also taken on his line and is giving it national distribution in that field. Other branches of national trade are negotiating for it.

Here is how Drury built the business, beginning in the Fall of 1928. He knew nothing of chemistry or the technique of leather. But he wanted a waterproof dressing and he went after it as Edison would have done had he been in his place—that is, by making scores upon hundreds of experiments. He says that he mixed together almost everything in the world that was wet enough or slippery enough to mix.

Finally, he had the product, and having gone that far, he decided to commercialize it. His first "commercial" batch was mixed in the basement on an old range, in two peanut cans.

SO FAR, so good. Into production at last. Now for the sales end. The contents of the big cans, in neat little cans, he took around himself to dealers' stores. He didn't know how to sell, but would leave samples. After some weeks, he would return to see if they had tried it. In some cases they had, and he would get small orders. It was slow work. In the first year he had disposed only 60 dozen small cans.

Then, all of a sudden, it began to "take," without advertising but by the grapevine route. From that time on, the growth was almost spectacular. All through the depression, each and every month has shown an increase over the preceding month. From the 60 dozen in 1929, the business has grown until thus far this year, over 22 tons of the product have been sold, and another single order is in for 20 tons. *(Continued on page 101)*

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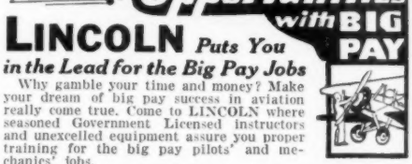

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Secrets of Success

HIS DISCOMFORT LED TO BUSINESS SUCCESS

(Continued from page 100)

Nevertheless, he still does his own mixing under his own secret formula. He has moved five times in five years (into houses with bigger basements), and is still in the same kind of a lay-out—a great, rambling old house, with "factory" downstairs, display and stock on the ground floor and living quarters above. People are after him to show him how to run his business in a "big way." They come and lay down cold cash and try to buy in. But he is firm in his intention to own it himself and make it grow big, but out of its own earnings.—H. W. Y., Portland, Oregon.

• • •

TENNIS PLAYER MAKES SPARE TIME MONEY

I FINISHED school last spring and found myself without a job that would supply me with even spending money. Taking stock of my capabilities, I found that about the only thing I could do even passably well was playing tennis—and stringing tennis rackets. I approached the manager of the only local sporting goods store of any importance with a proposition that he let me do his tennis racket restringing work. Fortunately for me he had decided to do this work himself. I could see no alternative then but to go into the business independently.

A letter to a tennis string manufacturer, whose name I obtained from a magazine advertisement, brought a prompt reply. I purchased a small supply of strings and the manufacturer included several display cards and a number of booklets to be distributed to tennis players. The sum of just one dollar covered the cost of the essential tools—three stringers' awls and a rubber-covered dowel. I printed my name and address on the "Tennis Rackets Strung" sign and fastened it to the fence which surrounds the local public courts. Almost immediately business commenced coming my way. The father of one of the younger players brought me a racket to string for his boy's birthday. This job which took no more than a couple of hours netted a profit of about $1.75. A few days later a student at the local college brought me the rackets of two of his friends to be strung with silk strings. These tangible results increased my enthusiasm, and to *(Continued on page 102)*

draw me!

COMPETE FOR AN ART SCHOLARSHIP

Copy this girl and send us your drawing—perhaps you'll win a COMPLETE FEDERAL COURSE FREE! This contest is for amateurs, so if you like to draw do not hesitate to enter.

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RULES FOR CONTESTANTS

This contest open only to amateurs, 16 years old or more. Professional commercial artists and Federal students are not eligible.

1. Make drawing of head 5 inches high, on paper 6 inches square. Draw only the girl, not the lettering or border.

2. Use only pencil or pen.

3. No drawings will be returned.

4. Write your name, address, age and occupation on back of drawing.

5. All drawings must be received in Minneapolis by February 26th, 1934. Prizes will be awarded for drawings best in proportion and neatness by Federal Schools Faculty.

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Address .....

City ..... State .....

Secrets of Success

TENNIS PLAYER MAKES SPARE TIME MONEY

(Continued from page 101)

the sign hanging at the courts I added a small box containing booklets of "Tennis Hints" supplied by the tennis string manufacturers. Inside the front cover of each copy I had rubber-stamped my name and address. This inexpensive advertising brought me several jobs a week during the tournament season at profits ranging from $1.75 to $5.00 on each.

I had obtained, direct from the manufacturer, a particularly handsome racket for my own use, and a prominent local player was so attracted to it that he demanded one "just like it". The profit from selling the racket was so welcome that I decided to take a chance, and I ordered eight additional racket frames. These were disposed of, strung to order, long before the season was over. Indeed, I had to order several additional rackets after the additional supply was exhausted, and might have sold many more had they been on hand.

The sale of tennis balls, racket covers, presses, rubber grips, and similar accessories, together with repair jobs, brought in a number of extra dollars. The total profit for the few months of easy work requiring only a few spare hours each week exceeded $125.00.

Forearmed with the knowledge that there is plenty of profit in the tennis "racket", I shall next spring rent a small store, or space in a larger one, and continue wholeheartedly in this interesting business. D. B. H., Clinton, Iowa.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

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Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

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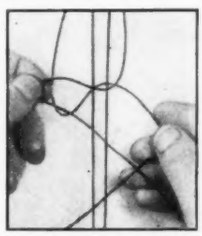
A QUICKER WAY TO TIE SQUARE-KNOT WORK

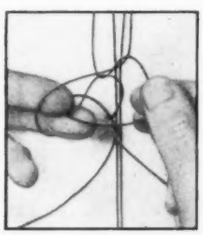
AFTER the square-knot enthusiast has had some experience in making belts and other usable articles with cords and knots, he will save considerable time by mastering the unique tie shown in the accompanying photos. The new tie enables the worker to make the knot in one quick operation, but it must be practiced in order to obtain speed. Only one cord need be pulled through the knot, the other falling free automatically.

The first operation is to start making the first half of the square knot in the usual manner, as shown in Fig. 1. However, do not pull out the cord shown in the left hand. Draw it back slightly with the thumb until the loop is around the first two fingers; then, with these fingers, reach over the two free cords that are held taut by the square-knot hook and grasp the cord held in the right hand, as in Fig. 2. The finger and thumb of the right hand then reach underneath the free cords and grasp the loop that was around the left fingers in Fig. 2, as shown in Fig. 3. It is necessary that the right thumb and finger pass only under the cords caught on the knot-hook, and not around the knot cords. The loop is pulled on through the loop shown in the right hand (Fig. 2) and should then appear in a tangle as in Fig. 4. Pull the cord in the right hand entirely through the knot and the tangle will disappear. The cord at the left will drop free leaving a completed square knot ready for tightening.

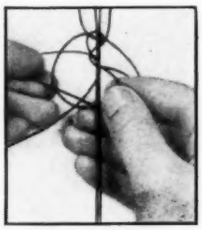
With the regulation method of tying one half of a square knot at a time, it is necessary to pull the ends of the cord through each knot twice.—KENNETH MURRAY.



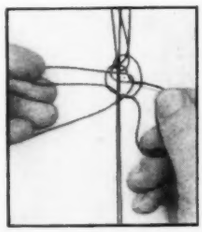
1 The tie is begun in the usual way and a loop is formed with the left fingers



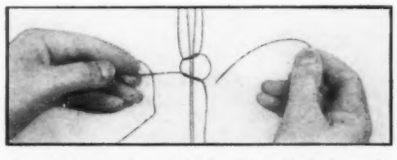
2 The left fingers then reach over to grip the cord held in the right-hand fingers



3 The right thumb and finger pass under the two taut cords



4 The left loop is pulled through the right loop in Fig. 2



The right-hand cord is finally pulled through

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Tripod Floor Lamp

GIVES PRACTICE IN FANCY WOOD TURNING

By Herman Hjorth

Author of *Basic Woodworking Processes* and *Principles of Woodworking*

This decorative floor lamp has a convenient little table halfway up

FLOOR lamps are indispensable in the modern home. They are decorative and useful, and their mellow light is kind to your eyes.

For one who has had some experience and practice in wood turning, the construction of this lamp should prove quite simple. The turning of the lower column needs no further explanation than that contained in the detail drawing. Have its upper end run on the dead center because of the hole to be bored in it.

Its slenderness makes it necessary to steady the upper column during the turning process. If your lathe is not furnished with a back rest, a homemade one, as shown in the sketch, can quickly be made. To avoid burning by friction, the stock should move freely in the square opening, and it should be rubbed with a piece of dry soap. The ⅜-in. hole in the end may be bored by moving the steady rest to the end of the piece. Use either a bit held in a lathe chuck or a ¼-in. skew chisel.

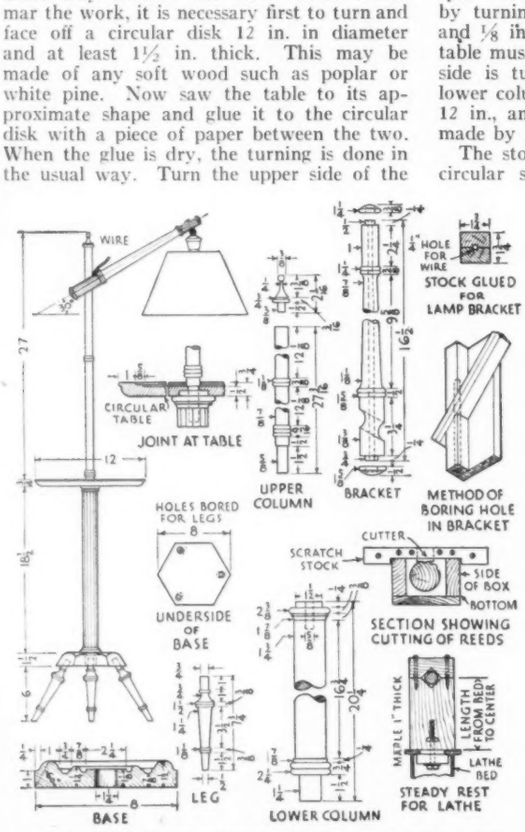
The square hole in the steady rest is now enlarged to fit the top of the lower column, in which the ⅝-in. hole for the end of the upper column is bored.

The table should preferably be turned from a solid, well-seasoned board. As this cannot be fastened to a faceplate in the usual way because the screw holes would mar the work, it is necessary first to turn and face off a circular disk 12 in. in diameter and at least 1½ in. thick. This may be made of any soft wood such as poplar or white pine. Now saw the table to its approximate shape and glue it to the circular disk with a piece of paper between the two. When the glue is dry, the turning is done in the usual way. Turn the upper side of the table first and bore the ⅝-in. hole. When finished, the table is separated from the pine disk by inserting the blade of a thin chisel between the two. This causes the paper to split. A chuck is now made from the disk by turning a projection 10 in. in diameter and ⅛ in. high on it. The recess cut in the table must fit tightly on this while the lower side is turned and the hole bored for the lower column. If your lathe does not swing 12 in., an ordinary round table top can be made by hand.

The stock for the base is next sawed to a circular shape. Before screwing it to the faceplate, place a piece of thin wood between the two. This is done to prevent the chisel from cutting into the iron when the hole is bored. After completing the turning and fitting the end of the column into the hole, remove the base from the faceplate and lay out the hexagon on its underside as shown. Saw away the waste wood at an angle.

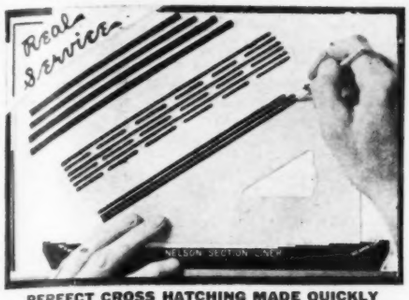
Turn the three legs according to the detail drawing and bore holes for them in the base at an angle of 60 deg. Make a boring jig from a piece of 1½-in. stock and clamp it over the point where the hole is to be bored. In this way all the holes will be bored at the same slant.

The bracket must be made of two pieces, in the center of each of which a groove ⅛ by ¼ in. is cut for the electric wires. These pieces are then glued together. When the glue is dry, a ⅞-in. hole is bored at an angle of 30 deg. in one end. Note the boring jig shown in the sketch. The bracket is finally turned between centers. The two buttons that fit over the ends are turned on a screw



Assembled lamp; columns, bracket, and table; how the base is turned and cut hexagonal; other details

THE NELSON SECTION LINER



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chuck. The bracket should slide easily, but not too loosely, on the upper end of the column.

The reeds on the bracket and lower part of the column can be cut as shown with a scratch stock (see P. S. M., Dec. '33, p. 80). Make a box as indicated in the sketch and support the column on two screws passing through the ends of the box. Find the length of the circumference of the column by wrapping a strip of paper around it. Divide this into twelve equal parts and lay out on the surface of the column. Wedge the column in the box and scratch a reed at every division.

The finish may be applied in the lathe as each piece is turned or in the usual way after the lamp has been glued together. (For information about finishing see P. S. M., Dec. '33, p. 81.)

List of Materials

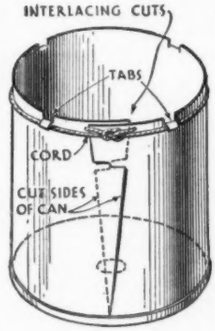
No. of Pieces	Description	T.	W.	L.
1	Base	1½	8	8
3	Legs	1½	1½	7¾
1	Column	2⅜	2⅜	20¼
1	Column	1⅛	1⅛	27 3/16
1	Finial	1⅛	1⅛	2 1/16
1	Table	¾	12	12
2	Brackets	⅞	1¾	16½
1	Button	1⅝	1⅝	½
1	Button	1¼	1¼	⅜
1	Brass nipple	⅜	1½	
1	Brass cap	⅜		
1	Pivot joint			
1	Socket and lamp shade			

NOTE: All dimensions are in inches and are finished sizes.

GARDEN STARTING POTS MADE FROM TIN CANS

ORDINARY tin cans make cheap and convenient pots for the indoor raising of plants that are to be set out in the garden later on. Take any can 3 in. or more in diameter and cut the top rim off. Then punch a hole in the bottom with a spike for drainage and cut the can down the side to the bottom. About ½ in. from the top of this cut, make two horizontal cuts about ⅛ in. deep. Then make four tabs spaced equally around the top rim. Squeeze the can together at the cut down the side, interlacing the two horizontal cuts near the top, and tie the can with a cord. Bend down the tabs at the top to hold the cord in place. Line the inside with paper to prevent dirt and water from seeping out through the side cut.

When ready to transplant from the can, cut the cord holding the can together, spread the can apart, and slide out the cylinder of soil. Peel off the paper and plant.—R. H. BUBB.



How to make starting pots from cans

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NEW CHEMISTRY TABLE FOR HOME USE

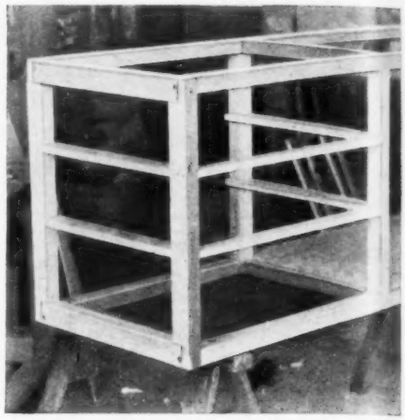
(Continued from page 64)

To attach the back assembly, engage dowels in the front edges of the stiles with holes bored in the notches of the top to receive them, and screw the plywood back to the table top. Brace the stiles at right angles to the top while this is being done.

Cut a piece of plywood for a door to slide between the stops in front of the two upper shelves, and screw on a wooden knob. This serves to keep children from getting at small bottles of dangerous chemicals that are stored in the top.

The fume cabinet sashes are doweled together. They are made up of square-edged stock, with the glass rabbet formed by mitering a rabbeted molding around the glass opening after assembly. Pine strips ½ by ¾ in., rabbeted ¼ by ⅜ in., are excellent for the purpose. Fit glass strips ⅜ in. square inside, butting the corner joints, but leave the glass out until after painting.

Hang the left sash flush with the inside of the end stile, using surface hinges. The right sash, however, has loose-pin hinges screwed to the back edge and mortised into the stile, the door edge being 1 in. back from the stile edge. To enable the pins to be removed, gouge grooves above them.

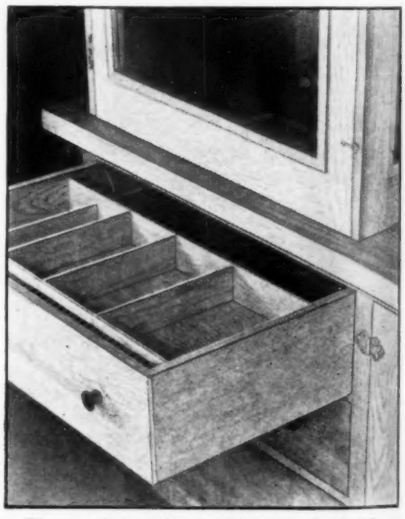


Left end of the main bench frame with the front drawer rails nailed solidly in place

Hang the front door to the left sash and screw on two small, flat hooks for latching. Bevel the edges for free clearance. To fold the cabinet, remove the pins from the front door, swing the right sash against the back, stand the door against it, and close the left sash over it. (The designations "right" and "left" are from the user's standpoint.)

The hood may be made of galvanized iron or other sheet metal. A tinner can do the work so easily and cheaply that it is hardly worth while to build it at home. Nail it with brads inside the apron cleats.

To make the cabinet tight, glue strips of felt along the inside of the hood apron below the cleats and under the front cleat, inside the center back stile where the door opens against it, and along the back edge of the left door and both edges of the front door. Strips of rubber from an old inner tube might be substituted. The lower edges of the sashes may be sealed with weather strip.



The top drawer fitted with a tray for holding glass and rubber tubing and small items

The base consists of three main pieces, mitered at the corners and attached with blocks to the underside of the cabinet. The setback gives toe room when one stands close.

To hold the dishpan sink, build an inclosing frame to attach to the table end by means of 7 by 8 in. steel brackets.

The water-bottle shelf is 8½ in. square, notched around *(Continued on page 107)*

LIST OF MATERIAL

No.	Item	T.	W.	L.
8	Top	2″	4″	6′ 0″
3	Stile, back	2″	4″	3′ 7″
2	Rail, center	2″	4″	1′ 9″
4	Rail, front and back	2″	3″	5′ 4″
4	Rail, end	2″	3″	1′ 11″
4	Stile, corner	2″	3″	2′ 6″
2	Muntin, center	2″	3″	2′ 2″
1	Shelf	1″	1′ 0″	3′ 0″
1	Shelf	1″	1′ 0″	2′ 1″
1	Front, drawer	1″	10″	2′ 4″
2	Side, drawer	1″	10″	2′ 1″
1	Back, drawer	1″	10″	2′ 3″
1	Shelf, bottle	1″	10″	10″
2	Hood apron, side	1″	8″	1′ 11″
1	Hood apron, front	1″	8″	2′ 7″
2	Front, drawer	1″	8″	2′ 4″
4	Side, drawer	1″	8″	2′ 1″
2	Back, drawer	1″	8″	2′ 3″
2	Base, end	1″	6″	2′ 0″
1	Base, front	1″	6″	5′ 4″
1	Miscellaneous	1″	6″	4′ 0″
2	Shelf, lower	1″	4″	2′ 11″
2	Rail, lower, cabinet door	1″	(net) 4″	1′ 6″
1	Rail, lower	1″	(net) 4″	1′ 11″
2	Rail, upper	1″	(net) 3½	1′ 6″
1	Rail, upper	1″	(net) 3½	1′ 11″
4	Slides, drawer	1″	(net) 2⅝	1′ 11″
6	Stile, cabinet door	1″	(net) 2½	1′ 11″
4	Stile, cupboard	1″	(net) 2½	2′ 2″
4	Rail, cupboard	1″	(net) 2½	1′ 6″
1	Edge, shelf	1″	3″	2′ 11″
1	Frame, sink	1″	3″	5′ 0″
4	Cleat, drawer and sink	1″	2″	1′ 9″
2	Cleat, sink	1″	2″	1′ 2″
4	Rail, drawer	1″	2″	2′ 4″
3	Guide, drawer	1″	2″	2′ 1″
1	Back, shelf	¼	3′ 6″	5′ 7″
1	Back, cabinet	¼	2′ 5″	5′ 7″
1	Door, top	¼	1′ 1⅝	2′ 10½
2	Door, cupboard	¼	1′ 5¼	2′ 1¾
1	Shelf	¼	1′ 11 15/16	2′ 11⅞
1	Partition	¼	1′ 11 15/16	2′ 3″
2	Ends	¼	2′ 1¼	2′ 5″
3	Bottom, drawer	¼	2′ ¼	2′ 2⅜
3	pr. Hinges, heavy butterfly			
2	pr. Hinges, loose-pin		2″	2½
2	Hooks and eyes, flat			1½
8	Drawer knobs, wooden		1¼	
1	Drawer knob		1″	
1	Elbow catch			
	Pipe fittings as shown			
1	Rectangular dishpan			
4	Steel brackets		(2-5″x5″, 2-6″x8″)	

NOTE: All the wood should be stock sizes of vertical grain fir or other soft wood, S4S, except the ¼ in. thick stock, which is three-ply fir. Net sizes are given for the plywood.

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NEW CHEMISTRY TABLE FOR HOME USE

(Continued from page 106)

the back stile and supported on two small brackets. Tack a small bead around the edge to keep the bottle from slipping off.

Before fitting and hanging the cupboard doors, stand the cabinet in its permanent place as the frame springs to suit the floor.

Mortise a small lock into the back face of the right door and put an elbow catch under the upper shelf. The drawers can be made secure by boring through the partition into the drawer sides, for inserting lengths of doweling screwed to small knobs. In this way the drawers cannot be opened until the cupboard is unlocked.

Paint the top of the table with some good alkali and acidproof material. If a ready-mixed paint is not easy to get, mix your own according to a recipe found in any comprehensive formula book. Two coats of boiled linseed oil are sufficient for the rest of the cabinet.

CORRUGATED SEPARATORS USED IN PLANT BOX

SEEDLINGS grown individually have a much better chance to develop complete root systems, and consequently make better progress when set out, than those grouped together in a box or bed. For such planting a knockdown box may be made to utilize the corrugated board separators from foodstuff cartons. The box dimensions should be planned to suit the separators used. In this case they were taken from a catsup carton. The ends of the box are mortised and tenoned as shown, and a hole is bored through the tenon to enable the use of half-round

Seedling box with one end removed to show the partitions, which are corrugated board

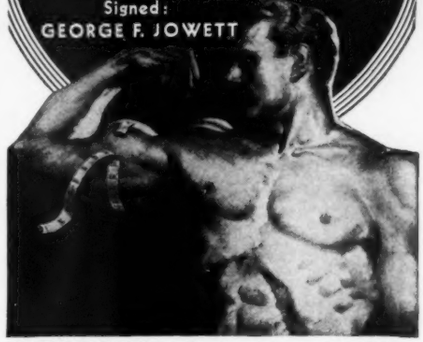
wedge keys for locking the parts together. The box is easily assembled, yet may be stored in a small space.

At planting time, when seedlings have attained proper size, one or more of the detachable sides are removed, a long thin knife is run through to slit the corrugations, and the earth cut into twenty-four sections, each holding one plant. These blocks hold their shape while transplanting and the rootlets within are undisturbed. Plants thus moved continue growth without wilting.

Painted, these boxes may be used over and over. They prove a real help to the gardener in both vegetable and flower gardens.—ELTON STERRETT.

When ordering back issues of POPULAR SCIENCE MONTHLY, *please send 25 cents for each issue except the current one and the three issues immediately preceding. These four issues are only 15 cents each.*

IF YOU do not add at least 3 INCHES TO YOUR CHEST 2 INCHES TO YOUR BICEPS . . . . it will cost you nothing!
Signed: GEORGE F. JOWETT



YES SIR! Three inches of muscles added to your chest and at least two inches to your biceps, or it won't cost you a penny. While my course is not infallible . . . so many of my pupils have gained tremendous physical development that I am willing to stake my reputation that I can do the same for you . . . *remember* . . . if I fail it costs you nothing!

I want to tell you fellows . . . there's something about this "strong man business" that gets you . . . *thrills* you! You'll get a great kick out of it . . . you'll fairly feel your muscles grow.

Those skinny fellows who are discouraged are the men I want to work with. Many an underweight weakling has come to me for help . . . completely discouraged . . . I have developed a real he-man's physique for them . . . covered their bodies with layers of muscles . . . made them strong and proud . . . eager and ready to face the world with their new power!

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It will be a revelation to you. You can't make a mistake. The reputation of the strongest armed man in the world stands behind this course. I give you the secrets of strength illustrated and explained as you like them.

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SATURN'S RINGS AND CANALS OF MARS

(Continued from page 41)

in photographs of our typewritten Mars model, as they do in the original.

An experiment which you can perform with two disks of cardboard joined by a bar shows the remarkable way in which the earth and moon revolve, each month, around their common center of gravity.

To make this idea plain, cut out cardboard circles eight and two inches in diameter, and join them by a strip so that the circles are separated by six inches. The center of gravity of this unequal dumb-bell will lie somewhere along the line joining the centers of the two disks. Find it by trial, puncturing the card with a pin until a point is found where the disks balance each other. This is the center of gravity.

Around this point draw a circle that passes through the center of the larger disk representing the earth. From the same point of balance, describe with your compass an arc passing through the center of the smaller disk, representing the moon.

If this earth-moon system is then whirled around a pin through the center of gravity, it will be seen that the centers of both earth and moon revolve around it.

To find where the center of gravity lies in the real earth-moon system, you must consider that the mass of the earth is eighty-one times that of the moon. The moon's center is therefore eighty-one times as far from the center of gravity as the earth's center is. With the moon's distance of 240,000 miles, the common center of gravity falls at a point within the earth, at about 3,000 miles from its center. When the moon is in the zenith, straight over your head, you will therefore know that the entire earth-moon system is revolving around an axis about 1,000 miles under your feet. Accordingly the earth's center travels, each month, around a circle 6,000 miles in diameter.

LABORATORY TESTS OF HOUSEHOLD CHEMICALS

(Continued from page 55)

The fact that iodine solution or a weak tincture of iodine turns blue when mixed with starch, provides the home chemist with an excellent test for starchy materials. Its presence in potatoes, baking powders, dessert powders, and other cooking ingredients can be detected easily.

To prove that alcohol is present in a simple mixture, simply heat some of the liquid in a test tube fitted with a cotton plug that has been dipped in an alkaline solution of potassium permanganate. If the slightest trace of alcohol is present, the cotton plug will turn green as the vapors pass through it.

The presence of cotton or other adulterants in wool fabric may be determined by a simple test. Count the number of yarns or threads in a small square of the cloth and then immerse it for exactly ten minutes in a gently boiling, five per cent lye solution. This solution can be made up by dissolving one teaspoonful of strong lye in twenty teaspoonfuls of water. At the end of the ten minutes, what is left of the square of cloth is removed from the solution, washed, and the remaining threads counted.

The woolen yarns in the mixture will be entirely dissolved, while cotton or linen threads will be uninjured. Wool is the only common textile fiber dissolved by this treatment, so the amateur analyst cannot go far wrong. By dividing the number of threads remaining by the count in the original and multiplying by one hundred, you can obtain the percentage of threads, other than wool, used in fabricating the mixture.

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MECHANICAL MARVELS SPEED BOULDER DAM

(Continued from page 19)

big test laboratories on the ground, place a dozen cylinders of concrete a day between the plates of giant screws, crushing them to check on the hardness of every batch going into the dam. The tests are made on cylinders cast eight hours before. Thus, if need be, construction can be halted immediately to replace faulty concrete.

EVERY day, whole trainloads of cement roll across the desert from the five California factories where it is manufactured. Coming from different locations, it has slightly different colors. To avoid unsightly patches on the face of the dam, all the varicolored particles are mixed by screw conveyors until the cement becomes a standard hue. Then it is blown through pneumatic tubes, sometimes as much as a mile and a half, to the central mixing plants where water and 280 kinds of gravel are added and the whole stirred by giant machines into smooth concrete. Twelve men, working in three shifts, turn out ten-ton batches at the rate of one every two and a half minutes.

Hauled by electric trains, the batches of concrete go to two different levels, to avoid congestion, and ride on cableways across the canyon to the particular column under construction. Men, standing on the dam with telephones in their hands, guide the slowing down and stopping of the huge buckets. By the rules of the government experts, no concrete is to be dropped more than five feet. Otherwise the heavier rocks might settle to the bottom and a mixture of unequal consistency result.

BY THE time the pouring is completed, half a million twelve-ton dump buckets will have crossed the cableways over Black Canyon. Five of these cableways will then be dismantled. The sixth, however, the largest in the world, will remain to carry turbines and other heavy machinery down to the power plant soon to be erected. This railway has six three-inch cables of steel.

Giant air cannons, firing concrete under a pressure of 100 pounds per square inch, form another spectacular feature of the work. They are used to line the roofs of the four fifty-four tunnels that have been blasted through the solid rock to divert the river around the dam while it is being built.

When the work is completed and the vast reservoir builds up behind the dam, these tunnels will be employed to carry water to the turbines of the power plant. The concrete lining, however, will not be called upon to withstand the wear and tear of the rushing water. Special hard-carbon steel pipes, thirty feet in diameter and polished smooth as glass, will do the job. Inside these pipes, the water will race to the steeper penstocks, thirteen-foot tubes of steel, where it will reach a speed of 120 miles an hour and develop four times the power created by Niagara Falls.

The two and a half miles of pipe necessary for the work will cost $11,000,000, approximately one-fourth the cost of the entire dam. The pipes will be rolled from steel so heavy that two sheets make a load for a railway car. Three sheets, each nearly three inches thick, go into every twenty-four-foot section.

During the next twelve months, the pouring of the concrete will be completed. In another year, the building of the power house and other permanent structures will be well under way. The erection of this greatest water wall of all history will soon be a reality, accomplished through the help of novel methods and scientific aids.

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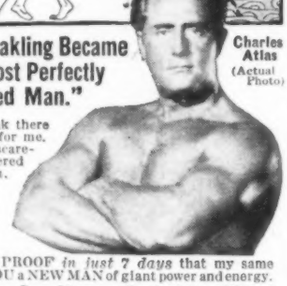

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EXPERTS SEEK WAY TO SAVE WORLD'S SWIFTLY VANISHING RECORDS

(Continued from page 33)

of the future. It is how to extend the life of printed matter and prevent deterioration of books, papers, and magazines. This is the end toward which recent efforts of science, such as the designing of the National Archives Building in Washington, has been directed.

Some years ago, the London Society of Arts and Sciences became alarmed at the manner in which leather bindings on books disintegrated in a few years. A special commission spent five years in an exhaustive study and reported that mineral acids, such as sulphuric acid, which are now employed in place of oak and sumac during tanning, caused the bindings to decay. As it is almost impossible to obtain leather tanned in any other way, ninety percent of the books in the main New York City library, for instance, are now bound in cloth.

AT THIS library, which houses nearly 5,000,000 volumes as well as manuscripts that date back to the Tenth Century, continual research along the lines of book and paper preservation are being made. Some of the tests have been carried out in conjunction with the U. S. Bureau of Standards. Rag paper, semi-tar boards, linen thread and buckram bindings have been found the most enduring materials for modern books.

Books, and even newspapers, published before 1870 were largely printed on high-grade rag paper and have withstood deterioration much better than later publications. In the New York Library, for instance, copies of newspapers more than a century and a quarter old, are still in excellent condition. In the same file rooms, however, newspapers of the 1880's and 1890's are so disintegrated that they cannot be rebound.

This is accounted for by the introduction of chemically produced wood-pulp paper which deteriorates rapidly when exposed to light and air. Preserving daily newspapers, which will form the textbooks for future historians of our rapidly changing era, is one of the most urgent problems confronting the experts.

At first, they patched the brittle pages, as they cracked and tore, with transparent adhesive tape. Then attempts were made to cover the sheets with liquids that would harden and protect the paper. Shellac, liquid celluloid, turpentine and paraffin, flexible varnish, nitro-cellulose, and a preparation of linseed oil and rosin were tried with varying degrees of success.

Some were sprayed on, others brushed on, others applied by dipping. Each had its drawback. Some of the treating fluids made the paper transparent, some made the ink run, some left the surface sticky, and all were expensive and hard to apply.

SO THE experiments at the New York Library tried pasting transparent material to the face of each page. Silk chiffon was tested first. It gave the paper sufficient strength but its open weave allowed the air to reach the wood fibers so the oxygen attacked the chlorine in the paper. Now Japanese tissue, hardly one thousandth of an inch thick, is glued with wheat flour paste to both sides of each sheet. Only one half inch is added to the thickness of a volume containing a month's daily papers by this procedure. Tests have shown that the tissue is stronger than silk. Where covering a sheet of newspaper with silk cost in the neighborhood of seventy-five cents, Japanese tissue can be applied for eight cents.

Since 1914, the New York Library has been experimenting with this method of treatment. Each year, several papers are bound in this manner, the cost being borne by the publisher and the copies being kept on file in the library. One newspaper is publishing its own rag-paper edition. This is expected to have the same lasting quality as a well-made book.

AT FIRST, pasting the tissue in place was a slow, laborious process. Recently special machines have been developed to speed up the work. After the sheets are treated, they are hung up to dry and then run through the steel rollers of a gas-heated mangle that irons out all irregularities.

An entirely different approach to increasing the life of newspaper records has just been announced in Rochester, N. Y. Roy S. Hopkins, research worker at the Eastman Kodak Company, has designed an apparatus that permits newspaper pages to be recorded on tiny films and then projected on the screen of a viewing device which reproduced the page half again as large as the original.

Eight pages of a newspaper can be copied on a strip of film one and three-eights inches wide and less than twelve inches long. The safety film, being more chemically stable than paper, can be preserved in files indefinitely. In the viewing apparatus, a cabinet which occupies relatively little space on a table, the pages are either thrown upon the screen at the bottom or are copied full size on photographic paper. The person consulting the files, can move the film to produce the page he desires by means of a simple hand lever at the side of the apparatus. This new method of recording newspapers in permanent form allows a month of fifty-page papers to be stored on a single reel of film four inches in diameter, and, if adopted, would make unnecessary huge storage racks for bound volumes.

At the same time, other workers are advancing a wide variety of additional suggestions for preserving the records of our times. In England, the British inventor, Everard Digby, has perfected a method of writing with platinum on sheets of gold. These two metals are virtually unaffected by weathering and decay and, according to the inventor, records made on them would last forever. His process consists of forming the platinum letters on sheets of gold about as thick as ordinary correspondence paper. Recently, it is reported, he was employed by the Duke of Norfolk to reproduce imperishably an ancient document that relates to that nobleman's family.

Frequently experimenters have tried to impregnate paper with various metals to increase its life. The result has been to injure the fiber of the paper and decrease, rather than increase, its durability. However, from Zurich, Switzerland, comes word that an inventor there has succeeded in accomplishing the feat by means of a special atomizer that sprays the paper pulp with a protective coating of tin, copper, or aluminum as it is being manufactured.

NOT long ago, in New York City, Dr. J. Broadman, a physician, announced the perfection of a secret chemical process which, he says, makes paper virtually indestructible. When the sheets of a newspaper are dipped into his varnishlike solution, he reports, their tensile strength is increased twenty fold and the print becomes more legible.

Thus by developing newer and more durable materials, on the one hand, and by producing scientific storage places like the new National Archives Building, on the other, experts are seeking longer life for the records of our times and civilization.

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BREATH-TAKING STUNTS TEST NEW PLANES

(Continued from page 28)

driver tries to change his direction of travel.

It is for that reason that we seek to learn the exact stability of each airplane, so as to make its flying qualities most pleasant for the passengers and easy on the pilot. Thus we determine the exact forces required to control these ships, as well as the effectiveness of these controls as they cause the planes to be maneuvered. Stability is the fundamental underlying these two qualities, and we measure stability as I have described: qualitatively through its oscillations when pulled off balance and quantitatively by measuring the forces on the controls.

WE HAVE not yet finished our tests in the aerial laboratory. What is the ship's performance? We must measure its speed within one mile an hour. Why must we determine speeds so accurately? Both because the manufacturer guarantees a certain speed even before the airplane is built, and also the airline operator must know if it can be operated economically, whether too much gasoline will pour down the hungry throats of the engines as they roar across the continent at high speed.

I sat at rest in the cockpit at Winslow, Ariz., the other day, the engines ticking over in unison with a promise of plenty of power for a unique flight. The field lies about a mile above sea level, and we soon were to ask one engine to take us off the ground and fly us to Albuquerque, 234 miles distant, with a full load. Never in the history of aviation has such a task been required of one engine at the moment of take off in a big machine.

As I sat waiting the signal to take off from the Winslow field, I felt sure of success. Quickly we gathered speed when the starter gave us the word. After traveling only half the length of the runway we were rolling 100 miles an hour, although the wheels had not yet left the ground. A moment later I reached forward to cut the switch on the left engine— and off we went.

Though that roaring power plant was hauling nearly nine tons of machine, lead, and people through the air, I never revived it up to full power. We circled the field, gaining altitude, and when we had climbed a thousand feet, I dumped a half-ton of gasoline, leaving enough in the tanks to carry us to our destination. Valving the gasoline was not a stunt in any sense, but was done to demonstrate that, should an engine cease functioning with a load of passengers, the ship could be flown to its next stopping place with ease. So easily did we complete the flight that I climbed to 8,300 feet to get over the continental divide on only three-fourths of the power from that one engine working alone.

Until the last year most increases in airplane speeds have been achieved through higher-powered engines, with little thought to the comfort of passengers. We began, not with a given sized plane, but with 1,400 horsepower, represented by two engines, and designed the plane to fit that power. In the resulting vehicle the world sees for the first time a multi-engined ship of the air that will fly hands off on only one engine, so perfectly is it balanced.

IT IS comfortable, but how about the noise? We have learned that airsickness traces back to irritation caused by vibration and the steady noise from propeller tips, engine vibration, and engines turning at different speeds. On our first flights when the cabin was only an empty shell, not even shouts could be heard. Then we began to measure the cabin noise, *(Continued on page 113)*

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BREATH-TAKING STUNTS TEST NEW PLANES

(Continued from page 112)

with listening phones leading to the sources. From this we learned where the sounds could be softened most effectively.

Of course, the acoustical engineer was consulted before the ship was built. Then by installing 200 pounds of soundproofing material, reducing noises at the source, sealing the cabin acoustically, reducing vibrations and rattles by such devices as doors locked at four points, and absorbing with soft materials much of the sound that actually enters the cabin, we attained an airplane whose passengers actually suffer less noise than they would hear in a pullman car. In coldest weather the temperature may be varied at will by steam heat from a tiny boiler behind the engine and by regulating the flow of air through the cabin.

ALTHOUGH they have achieved a comfort thought impossible two years ago, these ships attain high-flying speeds and low-landing speeds. Uncle Sam, through the Department of Commerce, seeks to hold down the landing speed of transports to sixty-five miles an hour. Gradually we have been increasing landing speeds as cruising speeds have jumped, though by no means in the same proportion. Air transports in time will be cruising 300 miles an hour across the continent.

Four hundred miles an hour? Undoubtedly we will reach that speed with safety at very high altitudes through our experiments in high-flying laboratories. Already we are able to shift gears by changing the angle of attack of the controllable propellers after taking off. This permits us to leave the ground with the engines delivering full power at high speed, then to throttle back while increasing the propeller's bite and maintaining high speed with the engines turning more slowly. Controllable pitch props eventually will make it possible for us to ascend to great heights, where storms never brew, and sail at velocities not now possible.

THIS SIMPLE MONITOR CHECKS TRANSMITTER

(Continued from page 61)

locked at this point, you can tune the transmitter by adjusting it until the signals are heard in the monitor earphones.

As you transmit, you then can use your monitor to listen in on your own signal. If at any time you must move the dial of the vernier condenser A to tune in your signals, it indicates that for some reason your transmitter has slipped off the desired frequency.

The usefulness of the vernier-adjusting condenser comes into play particularly when you want to test the adjustment of your transmitter at any time during a long series of transmissions on the same frequency. Like most amateurs, you probably will find one spot in one particular band that seems to give the best results for your conditions. If this is the case, you no doubt will adjust your transmitter to that point and leave it there. Your monitor then can be adjusted to that one point and the vernier dial alone used to indicate by its plus and minus whether you are below the desired frequency, above it, or directly on it.

Once you have calibrated your monitor, you can connect it and your receiver to a single pair of earphones through a double-pole, double-throw switch. When receiving, the switch can be thrown into the receiver side and when transmitting to the monitor side so that you can have a continual check on the quality as well as the frequency of your signal.

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THIS book was prepared for men of ideas—men who have an article in mind that will make money, save money, save labor or give pleasure. Leading thinkers agree that the opportunity for the inventor is as great today as ever before—that the world of a few years from now will be radically different from the world of today because of the contributions to progress that inventors will make. **Now is the time—if you have an idea—to see about fully protecting it so that you can be sure of your just share of whatever profits it may make.**

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Don't think that to be profitable an idea needs to be complicated. Simple articles—just a person's hunch—have often proved profitable. The crinkly hair pin, the metal tip for shoe laces, the paper clip, and literally thousands of simple things that most of us use constantly were all the product of invention. Also improvements on patented articles sometimes prove more profitable than the original article itself. If you have an idea—at least see what its possibilities may be and HOW YOU CAN PROTECT YOUR OWN RIGHT TO IT.

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Many a man has waited until too late to protect an idea by means of a United States Patent. Remember that someone else may be thinking along the same lines that you are; and the Patent Laws favor the man who gets his application for a patent on file in the United States Patent Office *first*. You may have much to gain—and nothing to lose—by acting promptly. Delays of even a few days can actually mean the loss of a patent. Learn the important facts about Patent Protection *at once*.

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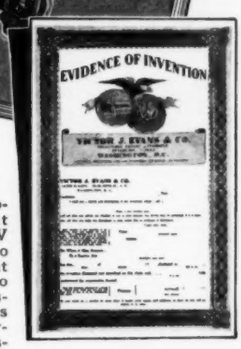

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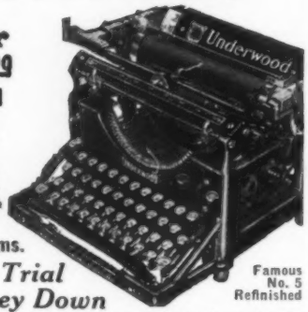

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Walker-Turner Co., Inc.

234 Berckman St., Plainfield, N. J.

VAST COUNTERFEITING RACKET FLOODS MARKET WITH FAKE PRODUCTS

(Continued from page 31)

tickets are to be printed. For an important event, a special design is made a part of the paper itself.

Yellows, golds, and oranges dominate the colors of the finished ticket. This isn't because sport fans crave richness and beauty, but because these colors are most difficult to unscramble. Even a craftsman of more than ordinary skill may lose details in photographing them. An additional safeguard is an elaborate raised seal placed on the back of the ticket by a secret embossing process.

All this has not deterred crooks from making counterfeits and selling them to innocent purchasers. But never since the new tickets were devised has the holder of a fake ticket been admitted to a fight.

AT ONE large event in New York City, the hurried ticket-takers accepted some skillfully printed counterfeits and tore off the seat stubs. But each time, that little routine action disclosed the fraud. The fake tickets tore like ordinary pasteboard. Whenever a genuine ticket was torn, its jagged edge showed that the card was made in three distinct layers. The two outer ones were pink. The center one was blue.

A new paper, developed by another company, is being introduced to manufacturers of various products. When used, it will probably cause incidents resembling demonstrations in magic.

A detective may examine a package of razor blades of a certain brand. He unwraps the third blade from the top of the pack, and moistens the paper. Nothing happens.

"Fake," announces the detective.

He takes from his pocket a genuine wrapper, seemingly the same as the other. He wets it, and the blade manufacturer's trademark appears!

The trick is accomplished by printing on a sort of base paper which is afterwards coated with a mixture containing casein and clay. The coating makes a blank, smooth surface, which can be printed on again. Moisture or a strong light will disclose the design underneath.

Hidden markings are already in wide vogue. Counterfeiters overlook them; they make it easy for investigators to distinguish the real from the spurious. Some manufacturers outsmart crooks by symbols stamped in plain sight, but continually changed according to secret codes.

The number, the magnitude, and the daring of counterfeiting plots today are explained by many theories. One explanation is that during prohibition, crooks learned the comparative ease with which liquor labels could be counterfeited and decided to try the same scheme in larger fields.

SKEPTICAL purchasers of whisky, during prohibition laughed at the imported labels on bootleg stuff. Yet many of them, mixed it unknowingly with bootleg ginger ale. The faking of that ginger ale, a leading brand, was one of the largest counterfeiting operations uncovered in recent years.

One of the chief figures in breaking up the plot, was Sam Friend, a special investigator. Representing various drug and food companies, he has probably taken part in checking more merchandise counterfeiting schemes than any other one man. With an office in New York, and contacts all over the United States, Friend has set out to be Enemy No. 1 of counterfeiters.

He tracked the ginger-ale fakers by following one apparently insignificant clue. The bottles were packed, like the genuine, in wooden cartons, nailed shut and bound with wire strips. Friend found where the strips had been bought. When the crooks came for more, they were followed to their own plant.

Detective work indeed is one of the most important weapons in fighting the counterfeiters. Not long ago it was called upon by two of the largest watch companies in the United States.

Watches bearing the companies' names were received for repair. When the cases were opened, the works were found to be of different and greatly inferior makes. They were of the cheapest kinds, some of them old and worn out.

THE workmanship on the face of a high-grade watch makes it a thing of beauty. One style is an example of the pains taken. The numerals and company name are engraved on a metal dial. The entire surface is then covered with enamel, which is ground and polished, until the metal is bright.

These counterfeit watches, however, had the company names painted on them. The work had been done by a stamping machine, such as is customarily used for repair work.

The matter was taken to the New York police. Captain P. J. McVeigh, of the detective division, put men on the job.

The detectives opened a jewelry store of their own and through it got in touch with the counterfeiters. They shadowed them, and found two dial factories, with thousands of dials already stamped with expensive names, and ready to be fitted to cheap works.

The trick of using a legitimate article as an aid in creating a spurious one, has many variations.

In 1930, the Newfoundland government authorized a special issue of stamps for the Boyd-Connor transatlantic flight. Upon the faces of engraved stamps of a regular issue, special lettering was printed with hand-set type. Only 300 were made, and almost immediately collectors were valuing them at about $500 apiece.

Simultaneously with the appearance in this country of the genuine stamps, there was a flood of counterfeits. The fakers had bought regular, engraved stamps, and had done their own printing over them.

COLOR happens to be one of the most frequent stumbling blocks for counterfeiters. A few months ago a large New York bank rewarded a clerk who had become suspicious of a check, drawn for a large amount, on one of the bank's regular customers. The signatures appeared perfect, but the clerk thought the pinkish tint of the lithographed background was off-color. Investigation proved the signatures were forgeries.

Several months ago, the police commissioner of New York City declared the lives of hundreds of thousands of people had been menaced by counterfeiters' operations.

"This wholesale attack on the health and life of men, women, and children," he asserted, after the arrest of several gangs, "was the most vicious ever organized. Whether deaths were caused as a result of poisonous substitutions we may never determine. The fact that so many of the persons endangered were children, and that many others were poor or aged or ignorant, emphasized the horror of the trade."

It was found that children had suffered convulsions from fake laxatives; ulcers had been caused by cosmetics; infections were brought about by lipsticks; counterfeit mouthwashes injured throat membranes, and disinfectants and deodorants that were supposed to be harmless, killed rats and rabbits in laboratory tests.

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS.

TROUBLES THAT MAKE CARS OIL HOGS

(Continued from page 62)

pipe. As the gases struck the metal, a misty coating of water formed on its cold surface.

"You see," Gus said, pointing to the tiny droplets that beaded the metal, "water and unburned gasoline. It's our old enemy dilution. Every car has it, but leaky pistons and rings allow more of it to reach the crankcase."

"Isn't there some way to prevent it?" asked Messler.

"Sure, but you can't eliminate it entirely. The best safeguard is to keep your motor in good condition. As for your driving habits, don't use your choke any more than you have to. You know, Tom, you probably won't believe it, but everytime you yank your choke button all the way out to start a cold motor, you force several ounces of raw gas into your crankcase.

"FOULED spark plugs and a skipping engine help to dilute the oil, too. Some of the unburned gas is bound to find its way past the pistons into the crankcase. And a carburetor that's set too rich will do the same thing."

"How can you tell when your oil is so diluted that it isn't doing its job?" asked Messler.

"There's no way that's particularly accurate," confessed Gus. "Maybe some day automobile manufacturers will equip their cars with some sort of dashboard meter that will measure the viscosity or thickness of the oil in the crankcase. Until then, the safest thing is to change your oil regularly.

"Of course, you can check it to some extent by watching your oil pressure gage. If the reading drops down to about half of what it was when you put in new oil, it's a fairly good sign that the oil is getting thin."

"Aside from dilution, why is it that some cars use more oil than others?" interrupted Messler.

"In most cases," advised Gus, "it's just a little reminder that the motor isn't running as well as it should. Of course, every motor is bound to use some oil, but when adding oil gets to be a habit, look for trouble. Bad bearings, loose-fitting piston rings, sprung connecting rods, and worn or scored cylinders are just some of the faults that show up in the oil hogs. Then there are leaks of all sorts.

"THE way you drive has a lot to do with how much oil a car uses," went on Gus. "A motor that's running at high speed or up long pulls is bound to heat up. Naturally, the oil will get thinner and weaker. Hot, thin oil not only leaks easier but it's bad for the bearings. It pits the Babbitt metal and makes it crumble. That's why some of the new cars are fitted with oil coolers. The oil is water-cooled.

"Then too, the faster you drive, the faster your oil pump will work and the pressure of the oil will increase. High oil pressure will force more oil into your cylinders and possibly through the bearings."

"Say, listen," grinned Messler. "Before you think of any more troubles, what's to be done with my car?"

"Well," Gus drawled, "you could get by with those rings for a while as long as the breather is open and the crankcase is ventilated. But to make a good job of it, I'd suggest new rings and a recondition job on the cylinders."

"Phew!" sighed Messler. "The way you were going at it a few minutes ago I expected nothing less than the advice that I get a new motor. Well, give her the works, Gus. Might as well have it done now as later on when things may get worse. Besides I may be able to save a little on oil."

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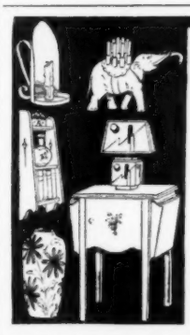

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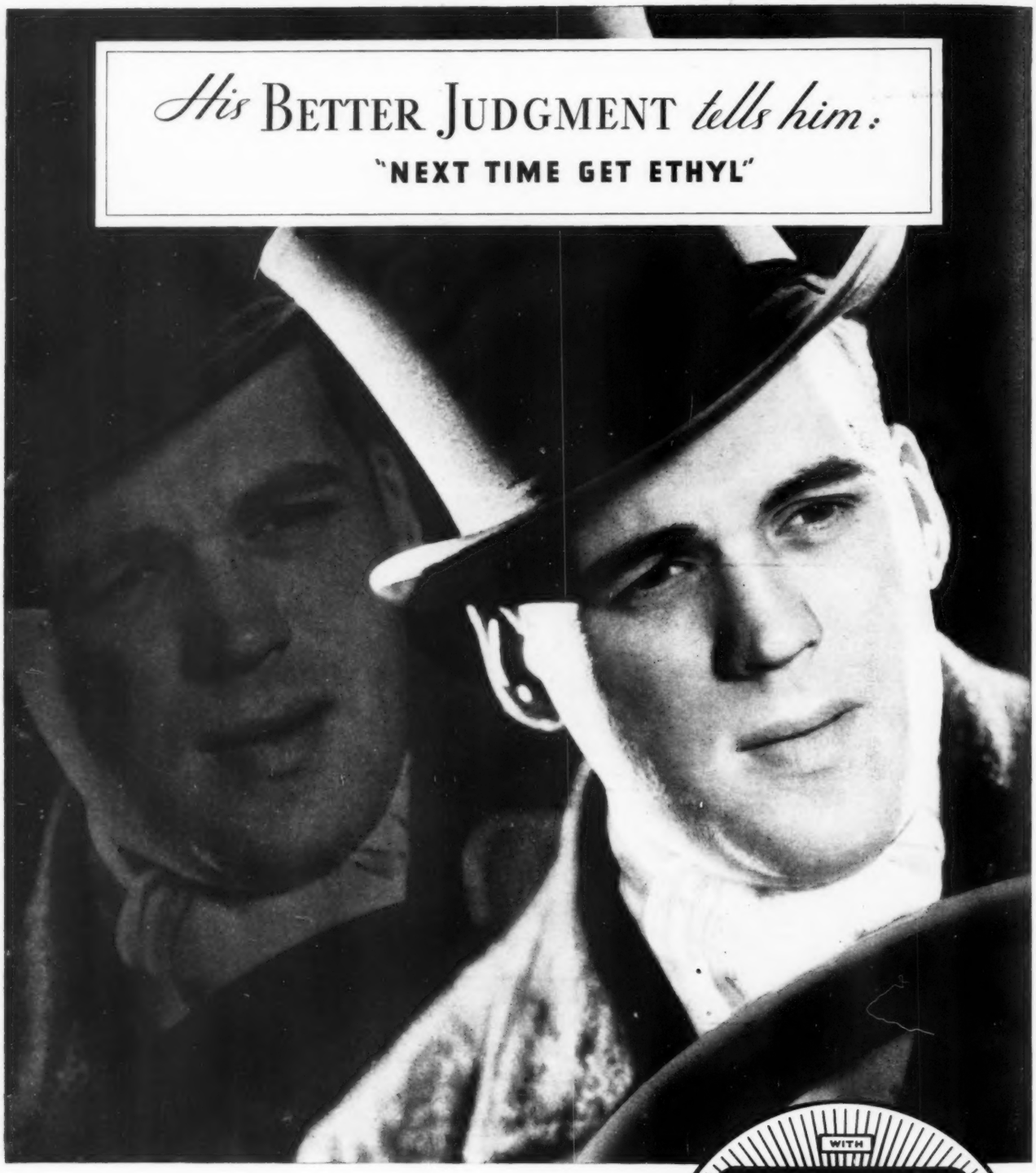

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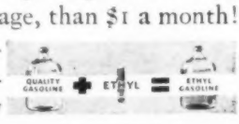

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Mrs. Phyllis L. Potter,
Montclair, N. J., *says:*
"I don't doubt but what it takes healthy nerves to ride an outlaw horse! But any woman who is a home maker will agree with me that shopping, cooking, cleaning, washing, and tending to all the other duties of running a household are enough to jangle *anybody's* nerves. I know that I have to be careful in choosing *my* cigarettes. I am a confirmed Camel smoker because I can smoke Camels freely without a hint of jumpy nerves. And they are the *mildest* cigarette I ever smoked!"

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How Are Your Nerves?

Fortunate indeed is that modern man or woman who does not get nervously upset. Raw, jangled nerves seem, all too often, to be the order of the day.

If *nerves* are your problem, we suggest a check-up now—on your eating, sleeping, and smoking. Get a fresh slant on your smoking by changing to Camels. Much is heard about the tobaccos used in various cigarettes. But this is a fact, as any impartial leaf-tobacco expert will tell you:

Camels are made from finer, MORE EXPENSIVE tobaccos than any other popular brand.

Everywhere you see Camels smoked more and more. People *do* care about mildness...about good taste...about their nerves. And Camels *never* get on your nerves...never tire your taste.

Camel's Costlier Tobaccos

NEVER GET ON YOUR NERVES . . NEVER TIRE YOUR TASTE